The Electrical Industry's Weekly Magazine November 21, 1960

Electrical World

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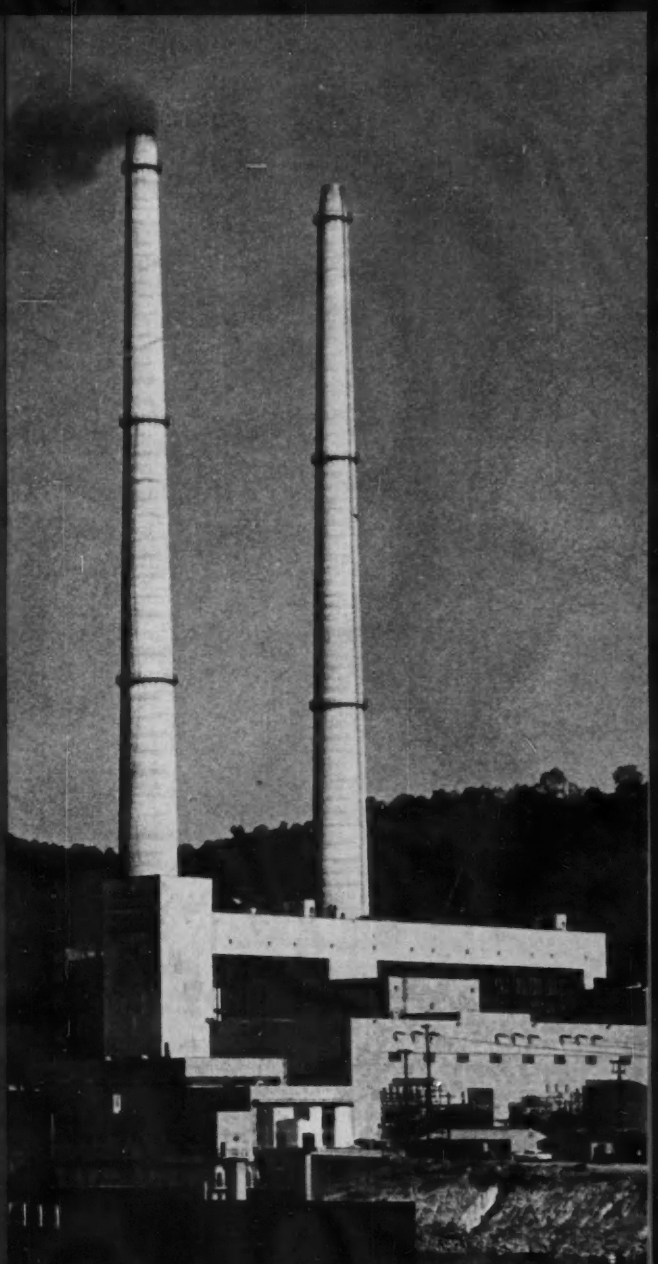
6th Steam Station Design Survey

... page 73

Reactor Containment Costs Cut By Pressure Suppression At Humboldt Bay

... page 68



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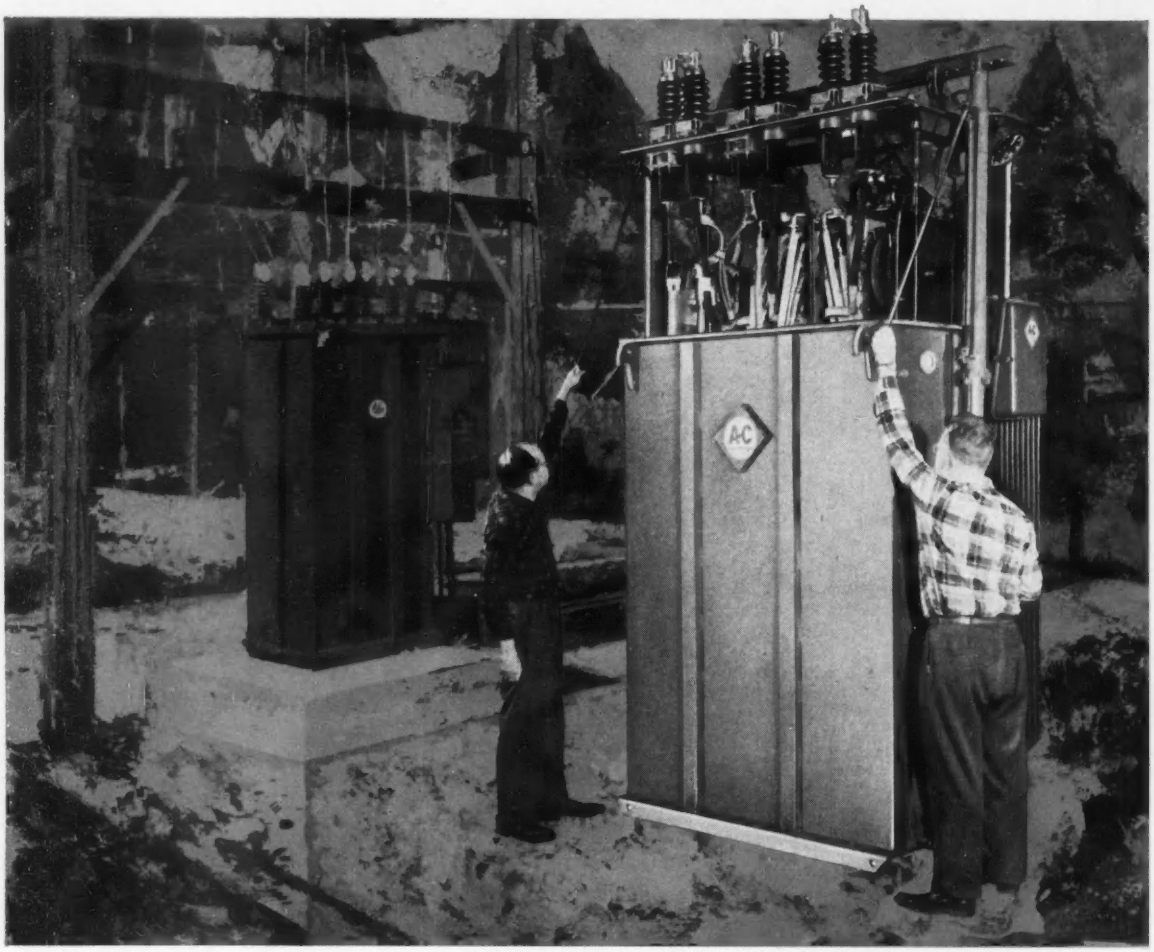
ORIGINATORS OF 5/8% STEP REGULATORS



SFR Feeder Voltage Regulator

Only exclusive unit construction delivers

extra regulator values you can see

Why is unit construction so important to regulator users? Simply because this design is *basic* to these many other extra-value A-C features *you can see*...advantages you can't find on any ordinary regulator!

You'll see continuous leads passing directly from the coils to the double-bolt terminals on the dial switch.

You'll see 78 fewer bolted connections only unit construction can offer. No leads to disconnect, no terminals to remove when you untank.

You'll see better workmanship, since all connections are securely made and double-checked *before* unit is tanked!

You'll see how much easier inspections can be. To untank, remove cover bolts and control compartment retaining nuts. Then lift entire assembly from the tank... there's no need to remove oil.

Your nearby A-C office has the facts on single and three-phase sizes from 2,400 to 69,000 volts... in ratings up to 2,500 kva. Or write **Allis-Chalmers,** Power Equipment Division, Milwaukee 1, Wisconsin.

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CALIBAND control — At the twist of the control knob, you can set or test voltage level and band width without changing voltage or interrupting regulated service.

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

NOVEMBER 21, 1960

Vol. 154, No. 21

Electrical What in the World . . .

Another new name appears on our masthead. S. A. (Sam) LaFaso has joined our ranks as circulation manager. Coming to *Electrical World* from a post as vice president (commercial development and publicity) of American & Foreign Power Co, he brings to his position outstanding experience in the electric utility field. Sam has been in this field for over 25 years, part of them handling sales, advertising, public relations with companies associated with General Public Utilities Corp.

As most EW readers know, subscriptions to the magazine are serviced by multi-publication salesmen who handle all McGraw-Hill periodicals. At latest count, the company has 12 weeklies, 3 bi-weeklies, 24 bi-monthlies and monthlies, and two weekly newsletters, making a total of 41. Of these, 38 are in the English language and three published in a foreign tongue.

Now this puts quite a responsibility on these men. They must know their products intimately—and they must know the needs and the desires of the readers. Moreover, being in personal contact with the readers, they often feed back to the editors valuable comments and information on reader needs.

Making sure that they are kept knowledgeable on all these matters is the province of a magazine's circulation manager. Needless to say, EW's circulation manager must know the power business inside-out. And this Sam LaFaso does. He's the most recent example of our policy of getting the best to serve you.

Chuck Hochgesang

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LONG LIFE AHEAD—Here a 1,000-foot run of the record Okonite cable is being pulled into a manhole on Los Angeles' Imperial Highway from a Department of Water and Power cable trailer. The loaded reel weighed 15 tons.

Cable'bility at work

Los Angeles installs oil-filled Okonite cable with largest conductor ever made for 138 kv

Cable'bility (cā'ble·bil'·i·ty) *new word. Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

It's a giant, this Okonite cable. Its single conductor is the largest ever made for 138 kv.

Installed in parallel underground circuits—each seven and three-quarter miles long—these low-pressure, oil-filled cables carry power generated by Los Angeles Department of Water and Power's new Scattergood Steam Plant. Each circuit can carry 231 mva at 138 kv.

The underground installation avoids the use of overhead structures in the vicinity of the Los Angeles International Airport, with its heavy air traffic.

Okonite Cable'bility was on the job long before the cable carried Scattergood's power. There was the cooperation in the cable's design with the DOWAP engineers . . . the painstaking construction and quality control at Okonite's Paterson plant . . . the careful cross-country shipment on reels containing an oil reservoir for each 333 feet of cable . . . the on-the-spot installation aid.

Most important, there was Okonite's 80-year background in designing and producing long-lived cables for other critical jobs.

Why not put Okonite Cable'bility to work on *your* next job? The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

***where there's electrical power . . . there's* OKONITE CABLE**

7811

Letters

Buying Curves Can Be Smoothed

To the Editor:

The series of articles describing current power equipment market conditions and including suggestions for improving relationships (EW, Management Newsletters, Sept. 5, 12, and 19) was well worth rereading. Of course, those of us on the buying side undoubtedly should exercise the maximum in statesmanship and I like the emphasis upon exerting more self discipline in expanding production facilities.

I believe there are definite incentives available for leveling out the cyclical buying curves. And recent performance does indicate a willingness on the part of operating utilities to absorb a fair share of overall research and development costs.

All should gain from an orderly but constructively competitive market. Sometimes we overlook certain intangible benefits because we are unable to accurately value them and I know in connection with some of this major equipment, back-up and service are important ingredients of an advantageous purchase.

You have performed an important service for the electrical manufacturers and the utility industry.

A. Paul Thompson, President
Iowa Power & Light Co
Des Moines, Iowa

'Pilot in Field Circuit' Article Clarified

To the Editor:

I would appreciate your publishing a statement to the effect that in the text originally supplied by the author of "Lamp in Field Circuit Pilots Motor" (EW, Oct. 10, p 64), there was no mention of any use as a turbine speed changer and no mention of throttle valves and, also, that the text made no reference to any Duquesne Light Co practices. You might wish to further point out that this application specifically refers only to split-field series motors used on alternating current supply. I have not attempted to use the circuit on direct current.

J. S. Brown, Chief Engineer
Duquesne Light Co
Pittsburgh, Pa.

Dateline . . .

Portland, Ore.—In the past few months Bonneville Power Administration has signed contracts to supply power to three big industrial customers—after a holiday of about six years from such contracts.

First was to sell Harvey Aluminum 75 Mw of firm and 75 Mw of secondary power under a 20-year contract.

Second new customer signed up is Webb & Knapp Inc, New York, which is going to build a new steel mill at Anaconda, Mont. This is also a 20-year contract, and is for 120 Mw.

Latest in the series is with United Pacific Aluminum Corp, Los Angeles, which is going to build an aluminum reduction and processing plant near Longview, Wash. The contract is for 45 Mw of firm and 45 Mw of secondary power, and is for 20 years.

At the same time the new contracts are being signed, BPA's sales to investor-owned utilities have dropped 19.5% from 1959. Sales to publicly-owned utilities increased 12.8%, and direct sales to industry are up 8.8%.

During the period that BPA was not adding new direct sales customers there was no power to sell. Apparently there is, now, but its availability raises some questions.

- How much of the power available is coming from curtailed allotments to investor-owned utilities?
- How much is coming from increased generation from improved stream flows? From new units?
- Will an Upper Columbia treaty between Canada and the United States slow curtailment of BPA sales to investor-owned utilities?
- Will a treaty make more power available for new or enlarged industries?
- Which—investor-owned utilities or industries—will have priority for the new power available?

(*Continued on page* 67)

ELECTRICAL WORLD
Vol. 154, No. 21 November 21, 1960

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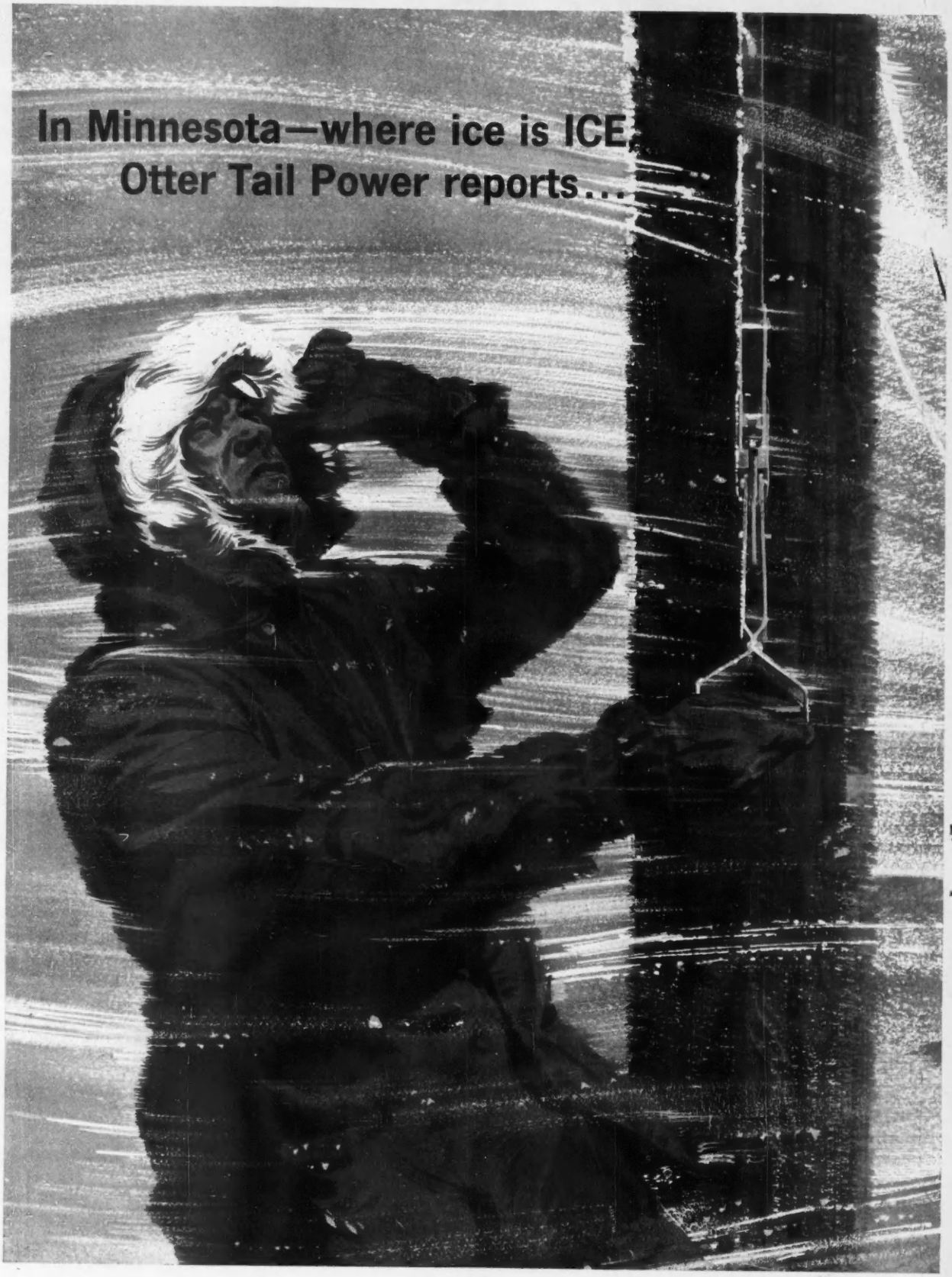
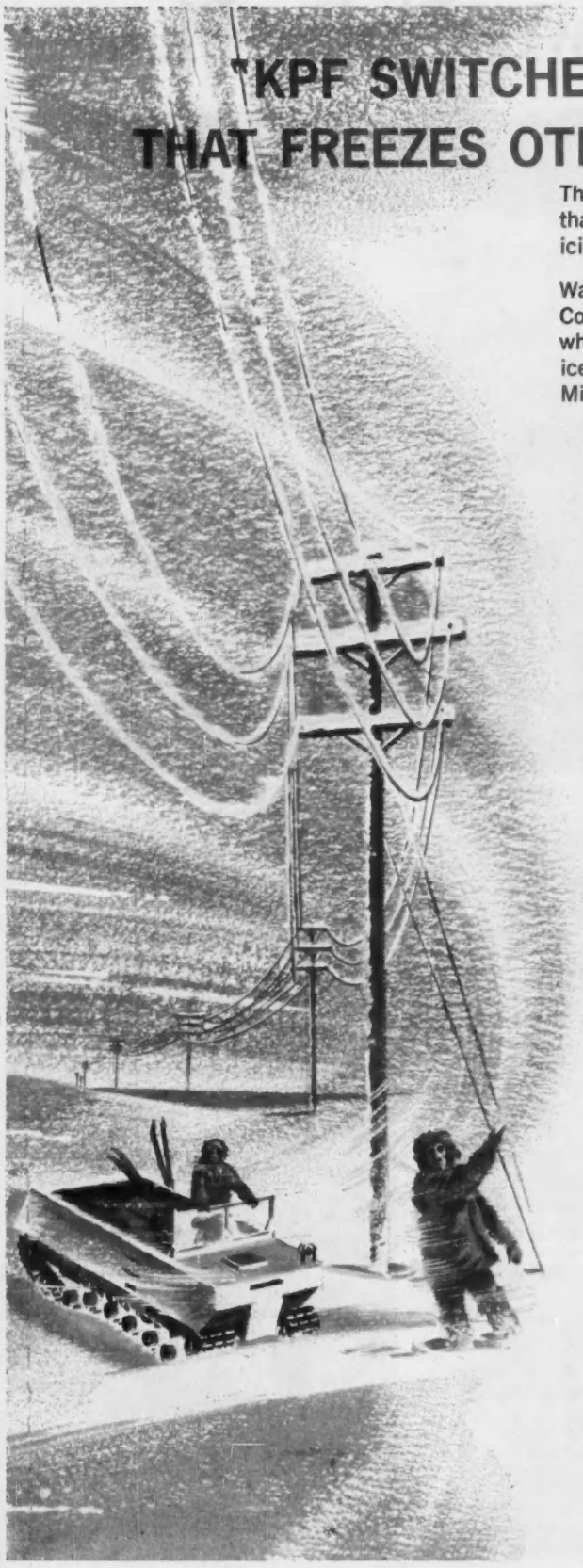

In Minnesota—where ice is ICE,
Otter Tail Power reports...



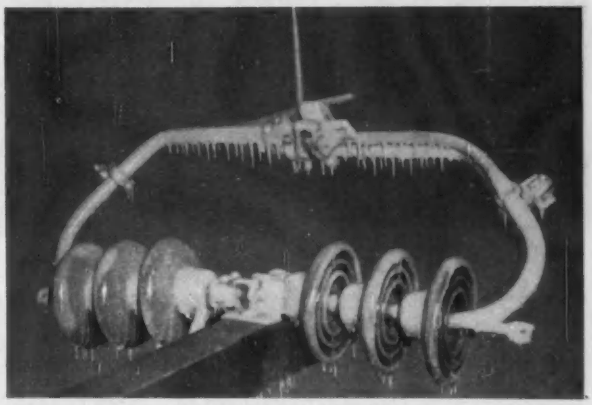
"KPF SWITCHES OPERATE UNDER ICE THAT FREEZES OTHER SWITCHES SOLID!"

The hard clear ice of northwestern winters — and the silver thaws of Texas — probably provide utility men with as much icing trouble as any set of conditions in the United States.

Warren Nye, Vice President, Electrical, of Otter Tail Power Company, has had his share of 80 mile per hour winter winds, whipping iced lines, and poles and switches sheathed in pure ice. Writing from his Company's headquarters at Fergus Falls, Minnesota, Mr. Nye says succinctly,

"We have found KPF switches easier to operate under conditions of ice than any other switch we have ever used."

HOW KPF SWITCHES CRACK OFF ICE



The mechanism of KPF switches is big, simple and rugged. There are no complex, finnicky doodads to freeze, bind or need lubrication.

A simple, positive-action control rod moves an interphase rod which rotates the blade arms of KPF phase units.

Blades and stationary clip holders are flexible so the moving arms can, literally, be "rocked" or "wobbled" by one man at the operating lever below.

The force exerted at the switchblade-clip holder position is many times that required to crack off the thickest natural ice.

The only time KPF switches have been not immediately operable under ice was when the entire pole and control rod assembly itself was sheathed in ice. It was necessary to clear ice to reach the operating lever and effect the "cracking off" process.

Install a KPF unit in your most demanding location - and watch its dependable, easy operation

KPF ELECTRIC COMPANY
P. O. Box 1257E • Stockton, California
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KPF
AIR BREAK SWITCHES
Standard for half a century

Kellogg's New Power Piping Plant

$4-Million Manufacturing Facilities Uniquely Equipped to Undertake Any Steam-Electric or Nuclear Assignment

Now in production at Williamsport, Pa., the Kellogg Power Piping Division's new plant is the most modern ever designed specifically to manufacture power piping for electric generating stations.

With these new facilities, Kellogg is equipped to undertake any steam-electric or nuclear assignment with greater efficiency, economy, and speed than ever before in its 40-year history of power piping leadership.

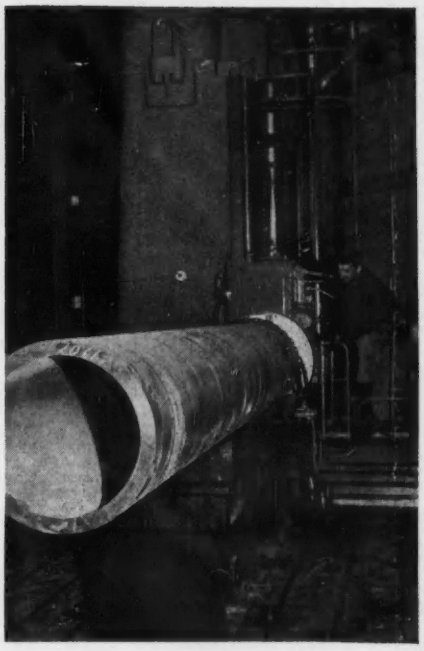
New equipment now in operation includes the latest machinery, worth in excess of $1 million, for machining, bending, and welding ferritic, austenitic, stainless, and other materials into piping of any wall thickness.

Carefully planned manufacturing sequences, on a production-line basis, assure a smooth and uninterrupted flow of operations from one end of the 900-ft. plant to the other.

Testing equipment for quality control includes the latest in electronic, radiographic, and ultrasonic advances. Two special vaults with 30-in. walls permit safe inspection with Iridium 192 and Cobalt 60.

Completely equipped metallurgical and welding laboratories, continually working to improve materials and techniques, aid in solving new manufacturing problems and are also available to clients as a service laboratory.

Kellogg's Power Piping Division welcomes inquiries on its new facilities, and extends a cordial invitation to engineers to inspect them personally.



POWER PIPING DIVISION • THE M. W. KELLOGG COMPANY

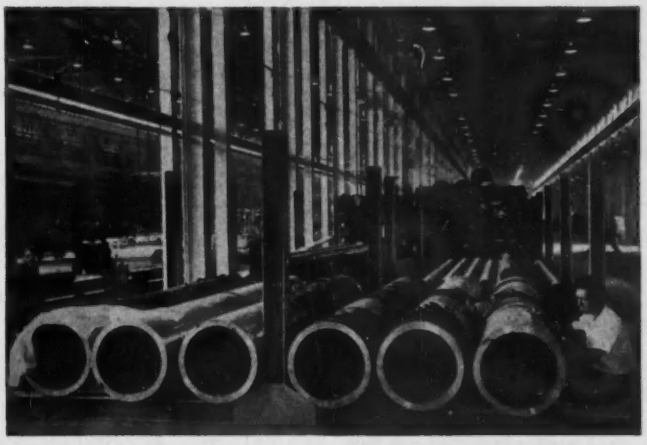
Plant and Headquarters: Williamsport, Pa. Sales Offices: 711 Third Ave., New York, N.Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

Offices of other Kellogg companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

Now In Production at Williamsport

New manufacturing plant and headquarters of Kellogg's Power Piping Division—situated on a 50-acre site at Williamsport, Pa.

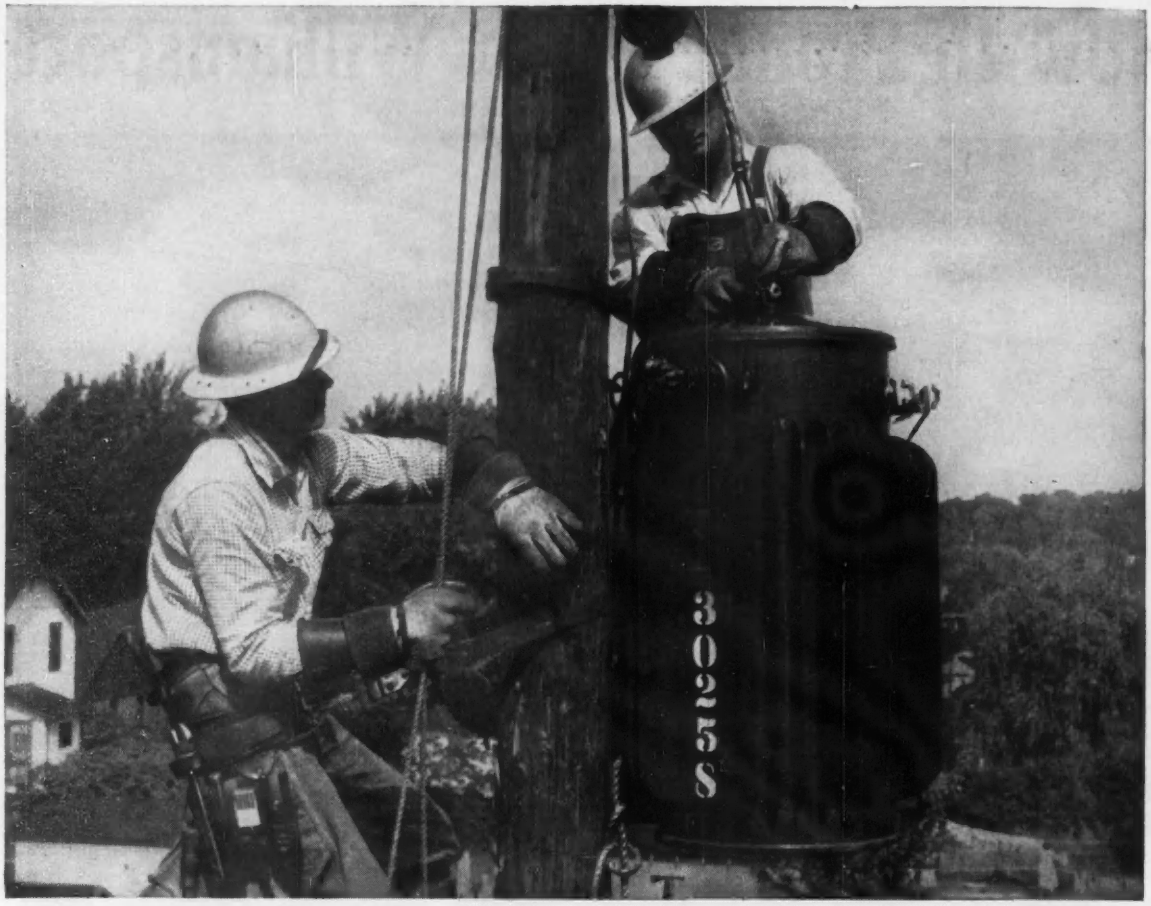


Above: Welding is a major phase of Kellogg's operations. Here, two thin-walled sections of stainless steel power piping are being joined by K-Weld—an inert gas-shielded technique of arc welding, patented by Kellogg, which assures long life.

Above: Raw materials bay, 40-ft. wide, extends the entire 900-ft. length of the plant. Piping and fittings are conveniently drawn from storage by overhead cranes and placed in the production line at any point in a planned manufacturing sequence.

Left: One of the new boring mills at Williamsport. Piping in machine is a stainless steel section—to be installed by Kellogg field erection specialists in the reactor sphere of a nuclear power station.

Left: Front entrance of Kellogg's new Headquarters Building. This ultramodern office building houses administrative, engineering, estimating, and accounting departments of the Power Piping Division. Sales offices remain at 711 Third Avenue, New York, N.Y.



UNIVOLT® 35 TRANSFORMER OIL

Superior Insulation—proved in use!

UNIVOLT 35 is excellent as an insulating and cooling medium. It serves so well because of its high oxidation stability, low power factor, freedom from acid, alkali and corrosive sulfur, and compatibility with the varnish finishes of coils. Its superior heat resistance properties make it particularly effective even under peak loads during the summer due to air conditioning.

Refined from carefully selected, high quality straight mineral oil, Univolt 35 is shipped to you with utmost care in handling. The tank cars used are specially prepared and inspected, and all loading is done indoors to prevent contamination.

Univolt N 36—a transformer oil possessing all the characteristics of Univolt 35 plus an efficient oxidation inhibitor — is also available.

For complete information, contact your nearest Esso office, or write: Esso Standard, Division of Humble Oil & Refining Company, 15 West 51st Street, New York 19, New York.

Esso

In industry after industry..."ESSO RESEARCH works wonders with oil"

the wrinkle

on this insulating paper reduces its dielectric strength 29% Anaconda's complete mathematical solution of the physics of insulating paper wrinkling is one of the great advances in EHV cable in twenty-five years.

FOR THE WHOLE STORY ON THIS REMARKABLE DEVELOPMENT, TURN THE PAGE. ▶

WHAT'S WRONG WITH A WRINKLE? Plenty, because even a modest average-size wrinkle destroys up to 29% of the dielectric strength in insulating tape. This may be the start of ionization, a weak spot waiting to turn into failure at the first severe switching surge to travel through your new EHV system.

HUMIDITY IS THE CULPRIT. When relative humidity rises above 35% paper tapes become thicker and longer because they absorb moisture from the atmosphere. If the tape is wrapped on a cable in this condition, its dimensions change drastically when the cable goes into the drying (impregnating) tank. The outer tapes become shorter as they dry, and tighten on the cable. The inner tapes not only become shorter, but thinner, too, which more than counteracts the tightening caused by longitudinal shrinking. Result: tapes no longer fit snugly around the conductor. You can't hope to compensate for all these variations by changing the original tension of the tapes, so Anaconda solves the problem by stabilizing the humidity below the critical 35% throughout the slitting, taping and takeup process.

TOP NOTCH CABLE DESIGN also demands consideration of such properties as the moduli of elongation and stiffness, coefficient of friction, and so on. At Anaconda it's now possible to predetermine proper taping tensions on a digital computer to obtain optimum compactness without wrinkles. All Anaconda cables are analyzed on our computer before the design is released for manufacture.

THIS SHEET OF INSULATING PAPER contains about 5% moisture by weight. It's *very* difficult to remove this moisture—but it must be removed to secure best dielectric properties. The solution to the problem: high vacuum: Anaconda uses oil-jet diffusion pumps, evacuates cables to less than one micron, (0.0002 pounds per square inch). Why doesn't everyone? Because at one micron, the last pound of water occupies a volume of 13,000,000 cubic feet—greater than the volume enclosed by all the pipe cables in the world. Only Anaconda's unique cryogenic pumping system can handle this volume. And the residual water content sets the ionization level for the cable, the dielectric strength and power factor.

Outstanding dryness like this is just one more demonstration of the unique product superiority that's possible only with Anaconda's Integrated Approach to EHV cable technology. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

SEE THE MAN FROM

ANACONDA®

FOR EHV CABLE

60226

Electrical World

NOVEMBER 21, 1960

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NEXT WEEK

BOILER EXPLOSIONS bend steel columns; cold-pulling straightens them.

LATE NEWS ▶ **Power Reactor Development Corp has asked** the AEC to extend the latest date for completion of the Fermi fast breeder one year—to Dec. 15, 1961—to permit redesign of the fuel pin "bird-cage" which failed in full-flow, high temperature sodium tests. Extension will require an amendment to the construction permit, now before the Supreme Court.

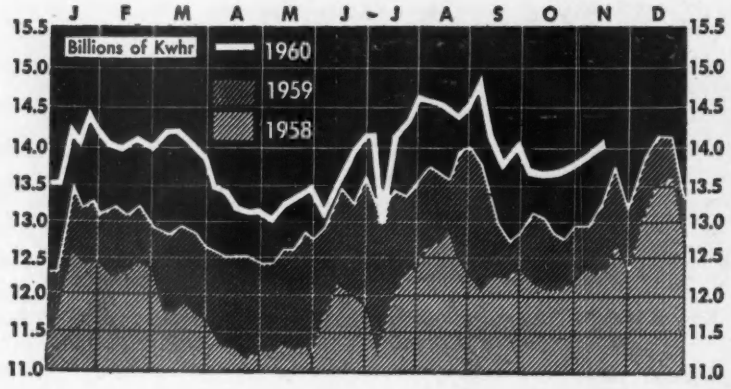
AEC gives GE permission to make changes in Vallecitos BWR design "within the parameters of the technical specifications, provided no unreviewed technical question is involved." For each change, GE must file with AEC a report with reasons why change does not involve unreviewed safety question. Any request to operate reactor over its 50-Mw (th) design level must be referred to Advisory Committee on Reactor Safeguards and have public hearing.

City Council of Niagara Falls, N. Y., will name a special committee to study the possibility of municipal power distribution. The city, which has a population of about 90,000, is at present served by Niagara Mohawk Power Corp. The resolution to establish a seven-man study committee was passed unanimously by the Council.

The US government has changed its position in the Philadelphia antitrust cases. It will continue to oppose *nolo contendere* pleas on seven indictments: power switchgear assemblies, circuit breakers, power switching equipment, power transformers, industrial control equipment, steam turbine generators, and steam condensers. On the other 13 indictments, the judge will now accept *nolo* pleas from individuals, but is undecided about corporate defendants. Meanwhile, the power switchgear assemblies trial has been postponed once again, this time to today. But there are growing doubts that any of the cases will ever go to trial, in view of the continual and fast-moving negotiations behind the scenes between government and defense attorneys.

Unevaluated bids for 800-Mw steam turbine generating unit for TVA show C. A. Parsons, Ltd as apparently lowest among two domestic and three foreign bidders. Comparison of bids is complicated, because GE and Westinghouse bids "without liquidated damages" clause and included 2.5% per year escalation. Brown Boveri, Parsons, and Associated Electrical Industries made firm bids and bid only on "with liquidated damages" clauses. Parsons bid-range was $11,203,000 to $13,215,000 depending on whether bid was for one or two units. Highest bidders were around $17,000,000.

WEEKLY POWER OUTPUT—Up 6.3% (Week ending Nov. 12), Kwhr 14,111,000,000



Per Cent Change From Previous Year

	Oct. 29	Nov. 5	Nov. 12
Total U. S.....	+ 7.0	+ 7.4	+ 6.3
New Eng.	+ 3.9	+ 5.7	+ 5.6
Mid. Atlan....	+ 5.5	+ 6.5	+ 3.8
Cent. Indust...	+ 6.8	+ 7.7	+ 4.6
West Cent....	+ 7.8	+ 7.7	+ 5.2
Southeast	+ 6.9	+ 7.0	+ 9.8
South Cent....	+ 9.2	+ 5.3	+ 8.3
Rocky Mount...	+ 8.1	+13.4	+17.2
Pacific			
NW	+ 6.1	+ 7.1	+ 3.1
SW	+ 9.6	+ 9.9	+ 5.7

Seasonally Adjusted Index 272.9

Week Ago 271.5 Year Ago 251.3

Source: Edison Electric Institute

Supply Lines

PRICES CONTINUE TO FLUCTUATE ON ELECTRIC EQUIPMENT ITEMS

The electrical equipment market remained in flux last week with announcement of prices changes on several key items used by utilities.

Price tags were revised by General Electric Co's Lightning Arrestor and Cutout Department on its line of open cutouts. Effective at 12:01 am Monday, Nov. 14, price increases of 3% were put on conventional open cutouts rated 7.8-kv, 100 amp, and increases of 5.2% were applied to loadbreak cutouts of the same rating. At the same time, the department announced price reductions of 2.3% on conventional cutouts and 0.5% on loadbreak cutouts rated 15-kv, 100-amp. According to Department Marketing Manager C. J. Graham, the changes are intended to bring the prices more into line with manufacturing costs. Along with the price changes, the department announced the availability of a new ultra-heavy-duty open cutout rated 15-kv, 100-amp with 10,000 amp interrupting capacity supplied with either conventional, mechanical, or gas load break fuse holders.

Reduction of 4.6% in its published prices on switched, poletop capacitor assemblies was announced by GE's Capacitor Department and became effective at the same date as the cutout price changes. This action follows the department policy of immediately adjusting published prices to reflect market levels. New prices being quoted are rounded to the nearest dollar so that the price of a 600-kvar, 2.4 to 13.8 kv unit, formerly quoted at $1,724.40, now becomes $1,645. The new prices apply to all voltage ranges and to parts of the assembly including the rack and the oil switch. However, prices of individual capacitor units remain unchanged. William G. Hart of GE's Capacitor Department reiterated that his department will continue its policy of publishing prices to reflect market levels.

It is known that at least one other manufacturer will follow GE on the new switched capacitor assembly prices, and others have the move under consideration. Meanwhile, reports are that price increases announced earlier this year on individual capacitor units are holding.

EMERGING IMAGE OF THE PA: GENERALLY FAVORABLE

The image of the purchasing agent, like the image of a presidential candidate, is partly molded by the public print. Within the past few months, the image makers have been busy on the PA and come up with some generally favorable impressions. Writing in the October Dun's Review, Clarence B. Randall, former president of Inland Steel Co, painted modern purchasing executives as a "proud lot" who have brought dignity to their job, and who sometimes command salaries commensurate with their new status. Randall, presently serving as a special assistant to President Eisenhower on foreign economic policy, displays a keen appreciation of purchasing problems and asserts that the purchasing man is making progress in winning recognition. "Few areas of business activity are today in greater ferment with new approaches to industrial problems than is buying," writes Randall. "Best of all, top management is now fully alerted to the importance of the receiving end of the business and fully challenged by the urgency of supporting its efforts."

A somewhat less glorified picture of the modern PA is painted in the August issue of the American Salesman. In that magazine in an article entitled, "The Modern PA: Bane or Boon for Salesmen," the buyers for original equipment manufacturers are described as "men of influence, generally willing to help, salesmen who

sell to them, say, but all too often they are sadly lacking in technical knowledge of the products they're called on to buy." The article was based on a survey of salesmen conducted by the magazine. The survey indicated that 92% of the salesmen responding gave PA's credit for being cooperative, and 90% of the salesmen reported that they kept the purchasing department fully informed of any negotiations with other departments in the company.

PURCHASING MEN'S QUEST FOR INFORMATION SHOWS BROAD INTEREST

The utility purchasing man finds it useful to keep tabs on a number of utility developments outside his own field. This is apparent from more than 650 responses (see table below) from utility purchasing men to an *Electrical World* questionnaire sent out within the past two months. While purchasing men in investor-owned utilities showed the greatest interest in their own field of purchasing and stores, they showed nearly as much interest in new equipment and news of engineering developments in distribution, and a healthy interest in numerous other areas such as late utility news, construction, operation, and maintenance.

Purchasing men in non-investor-owned utilities, while displaying somewhat less interest in the field of purchasing and stores, said that they found information in other utility fields of high interest. With these men, news of engineering developments in distribution appeared most useful. In appraising and interpreting the results below it is well to keep in mind that non-investor-owned utilities are generally smaller and the persons carrying the purchasing responsibilities in these very often carry other executive and managerial responsibilities.

What Kind of Information Do Purchasing Men Find Useful?

	Type of Utility			
	Private	Municipal	Rural Co-ops	Other Gov't
Types of Information	Very Useful	Very Useful	Very Useful	Very Useful
Latest News of Utility Industry	47%	41%	49%	48%
Utility Management Problems	36%	45%	58%	76%
Financial-Rates-Regulation	23%	20%	22%	24%
Government and Political News	21%	12%	19%	29%
Purchasing & Stores	62%	30%	33%	43%
New Equipment	58%	55%	56%	57%
Engineering News:				
Distribution	56%	74%	74%	81%
Transmission	43%	31%	24%	43%
Generation	26%	29%	9%	10%
Metering & Relay	30%	52%	41%	57%
Construction	39%	45%	63%	48%
Operation	37%	58%	69%	71%
Maintenance	38%	64%	69%	67%
Load Building	30%	32%	67%	57%

Enjoy the best Protection

The best protection you can buy is the Thorex Station Class lightning arrester. A measure of good protection is promptness with which an arrester can divert the lightning surge without affecting normal service. Here Thorex excels because it has the lowest IR discharge voltage of any arrester and is unique because it extinguishes the 60 cycle follow current arc well before voltage-zero.

Because the Dynagap (current limiting gap) so promptly extinguishes the arc, the silicon carbide valve blocks heat up very little. With its greater thermal durability, the arrester can withstand greater and longer surges than ever before. That means you can depend on the arrester for protection of important apparatus and circuits.

O-B Station Class arresters from 3 kv to 276 kv have one-piece continuous porcelain housings. Air-borne contamination, a major problem in many areas, has no damaging effect on the Thorex arrester's internal protective circuit since external leakage currents only bleed harmlessly down the outside. Also, Thorex station class arresters can be washed while energized with the same safety as other station insulation.

Enjoy the confidence that comes with using O-B Thorex Station-Class lightning arresters on your apparatus. They are backed by a name that inspires confidence:

OHIO BRASS COMPANY, MANSFIELD, OHIO

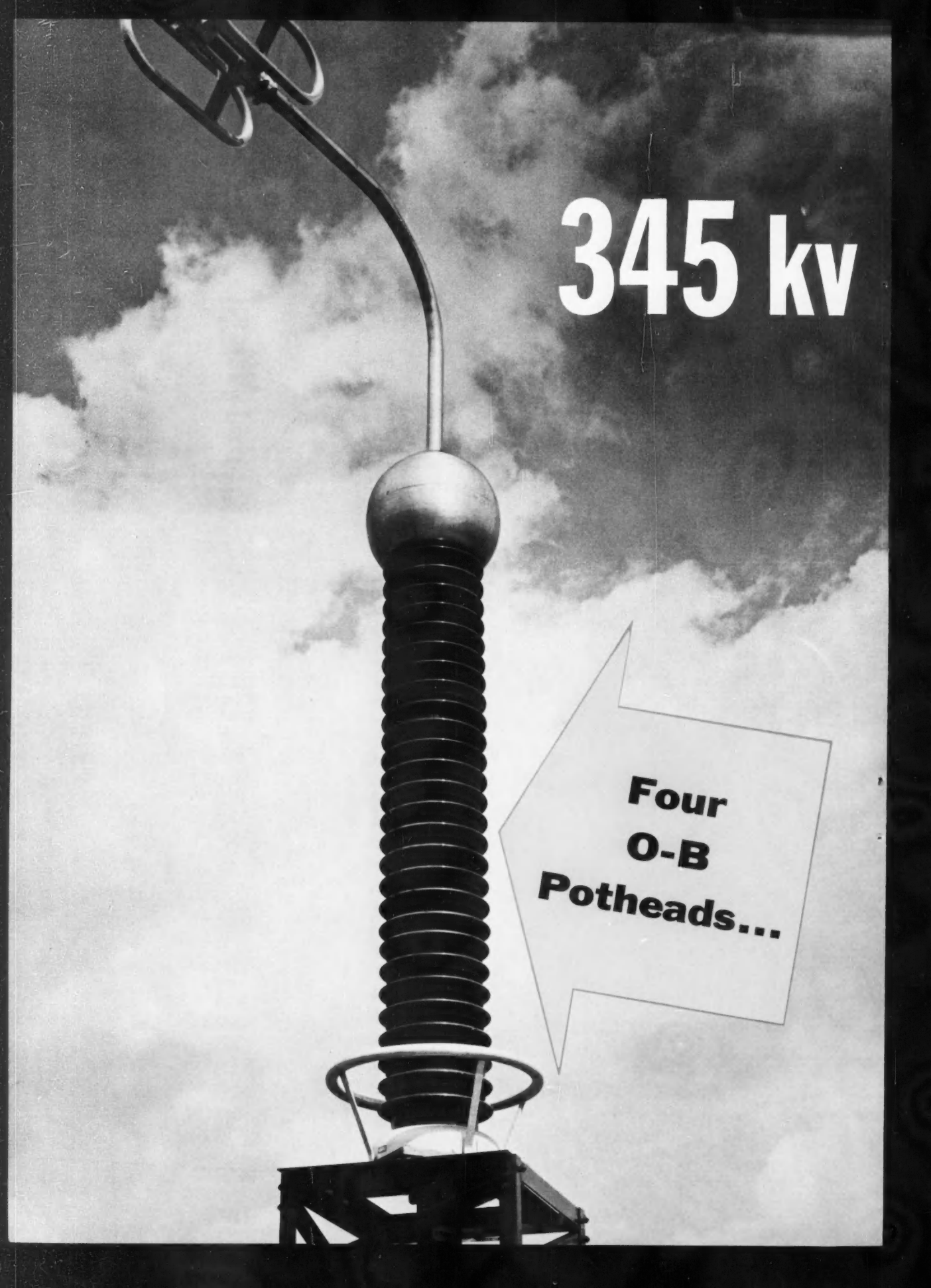
Ohio Brass

HOLAN

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BROKEE VALVES

10014-H1

Guard your important apparatus and circuits with Thorex station class arresters


345 kv
Four
O-B
Potheads...

Goes Underground

Four new O-B Potheads terminate one end each of four cables designed for 345-kv underground transmission. Test is sponsored by AEIC-EEI with the cooperation of Cornell University and several manufacturers of cables and apparatus, including Ohio Brass Company.

O-B's new capacitor-graded potheads are making an important contribution to the EHV test program. At extra high voltages, the electrical stress problems become complex, but O-B potheads give precise control over the radial and longitudinal stresses through series-connected capacitors and an accurately-formed stress cone.

Practical installation is another key feature of the O-B Pothead. The use of factory-assembled parts simplifies the installation procedure keeping field-installation time at a minimum.

This pothead was designed for 345 kv, but the same features are available in lower voltages. We will be glad to supply you with more details.

OHIO BRASS COMPANY, MANSFIELD, OHIO

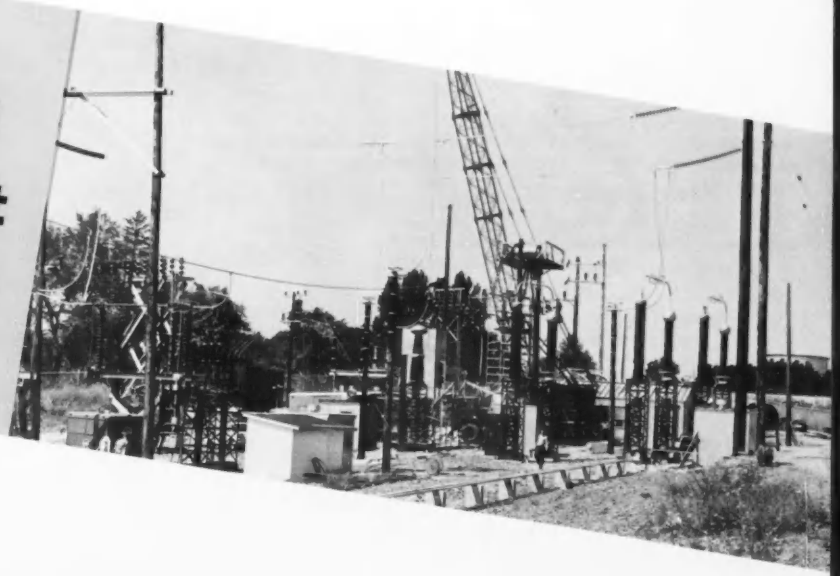
Ohio Brass

HOLAN

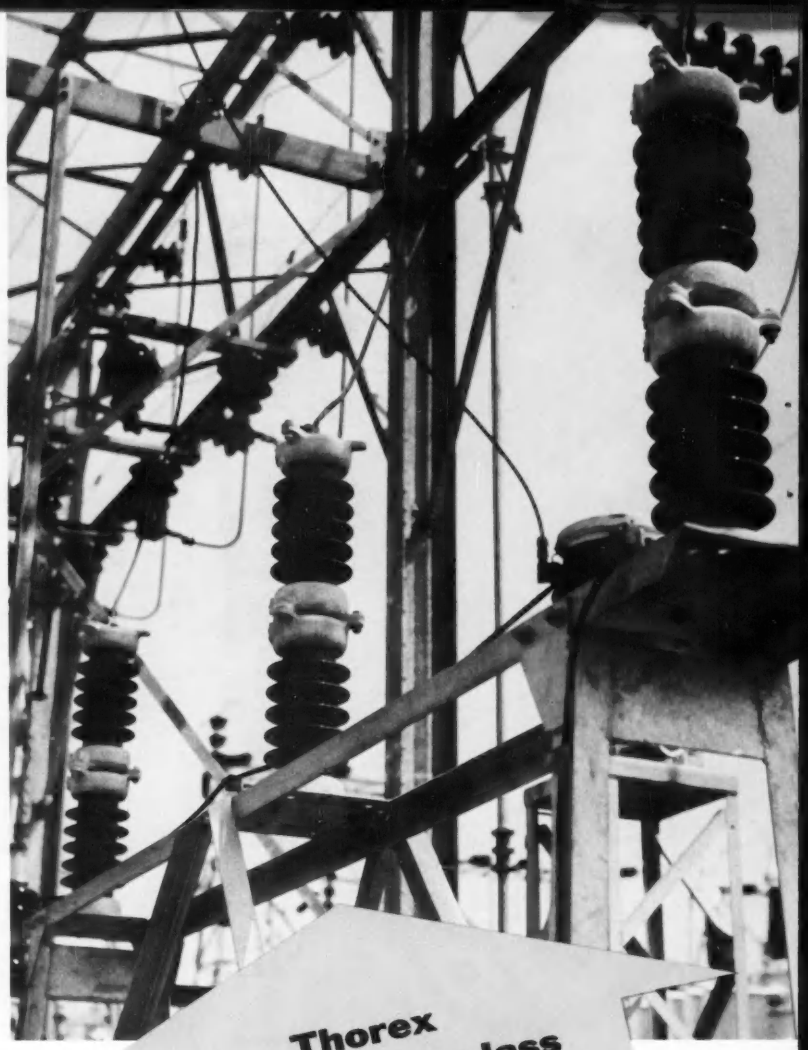
PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10014-H23

...installed on cables at Cornell test



Save arrester dollars



Thorex intermediate class offer lightning protection at low cost

O-B's Thorex Dynagap Intermediate Class arrester gives you maximum protection and durability for your arrester dollar. Since it enjoys the use of many heavy-duty Thorex Station Class parts, the Thorex Intermediate Class arrester exceeds even the ASA standard station class performance requirements in many of the essential categories . . . and sells at about half the station class price.

Thorex Intermediate Class arrester substantially exceed the low-current, long-duration durability requirements of ASA standards for station class arresters. It easily passes industry requirements of 65,000 amperes on the high-current, short-duration test. Its sparkover and IR discharge voltage values are the lowest of any intermediate class arrester.

These arresters are available in line-to-ground ratings of 3 kv to 121 kv covering normal operating voltages of 2,400 to 138,000 volts. Heights range from 10¾ to 108½ inches.

Are you planning new stations but are having the budget conflict with your need for protection? Or are you considering arresters for older apparatus? You can specify Thorex Intermediate Class arrester with confidence - - no other arrester gives you greater protection and greater durability for your arrester dollar.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

HOLAN

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10014-H4

NOMINAL WEIGHTS OF FINISHED WEATHER-RESISTANT WIRE AND CABLE

(Pounds per 1000 Feet)

Conductor Size AWG or Mcm	Copper & Copper Alloy Conductors				Aluminum Conductors	
	URC Type Double Braid	URC Type Triple Braid	Neoprene Type	Polyethylene Type	Neoprene Type	Polyethylene Type
Stranded						
2	246	270	248	**230**	105	**87.4**
4	155	170	163	**143**	73.3	**53.3**
6	103	115	108	**91.5**	51.5	**35.0**
Solid						
2	239	260	232	**219**	92.2	**79.2**
4	151	164	152	**136**	64.0	**48.0**
6	100	112	101	**87**	45.7	**31.7**

Sources: American Standards Association Specifications

This table shows

POLYETHYLENE covered line wire weighs less

Because it's the lightest, polyethylene-covered line wire is the easiest for linemen to string up . . . hardest for ice and snow loading, gale-force winds to bring down.

Polyethylene-covered line wire, depending on size and conductor, weighs from 5% to 32% less than other types. That's what the figures in the specifications tabulated above show.

This, of course, is no news to linemen who have strung all types of weatherproof line wire. They may not be able to quote pounds and percentages, but they all know you can't beat polyethylene on weight.

Linemen's Favorite Material

Light weight means easy handling, one of the main reasons polyethylene rates tops with installation crews. They also like polyethylene wire because it's clean . . . free-stripping . . . has a smooth, self-lubricating surface that almost makes pulling a pleasure. And despite the exterior slip, the plastic covering hugs the conductor tightly, doesn't ruffle as it goes over crossarms.

"Built-in" Safety Factor

Polyethylene's lightness provides lasting mechanical advantages, since span loads don't tax supports as much as heavier type wire. This "built-in" weight safety factor pays off when violent storms push aerial construction to strain limits . . . when ice and snow loads topple heavier lines.

An added factor in polyethylene wire's ability to stay up under adverse conditions is its smaller diameter. It offers less resistance to wind, a smaller surface for ice build-up.

Winning Combination

Called the "closest to the ideal covering for line wire," polyethylene is outstanding in other respects too. The shield it forms over wire is continuous . . . tough . . . resistant to aging, weathering, moisture, abrasion by lashing branches. It's good for decades of superior service marked by fewer outages, minimum maintenance.

When you order covered wire and cable, make sure the coating is made with PETROTHENE® polyethylene resins. PETROTHENE polyethylene costs no more, but it gives you premium weather and stress-crack resistance.

Polyethylene's advantages are outlined in an informative new U.S.I. data sheet, "Polyethylene . . . The Best Line Wire Covering." Also available is a data sheet showing properties, applications and specifications of PETROTHENE polyethylene compounds. Send for your copies today.

U. S. Industrial Chemicals Co.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.

Please send me:
- ☐ "Polyethylene . . . The Best Line Wire Covering"
- ☐ "PETROTHENE Resins for the Wire and Cable Industry"

Name:_____ Title:_____

Company:_____

Address:_____

City:_____ State:_____

USI INDUSTRIAL CHEMICALS CO
Division of National Distillers and Chemical Corp.
99 Park Ave., New York, 16, N. Y.
Branches in principal cities

Still in one piece
These arrester on pressure-relief test survives massive fault current...intact!
OHIO BRASS COMPANY, MANSFIELD, OHIO
Ohio Brass

★ This Ohio Brass page scored highest among all transmission and distribution equipment ads in its issue — and it rang the bell in reader response, according to these prospects. General Superintendent, Transmission & Distribution Operations: "(The ad) allowed me to review what is known about the O-B arrester. I called the representative, and when he comes in I will ask for engineering tests." Buyer, Purchasing & Stores: "I made a mental note of it, discussed it, and referred it to someone." Transmission Design Engineer: "I was told to read this, and I referred it to someone."

★ Each page of this 4-page, 2-color GE insert topped all other switchgear ads in its issue — and it got action! Buyer, Purchasing & Stores: "These ads keep us aware of what is new. They are now able to ship (these breakers) on notice. We used to have to wait for orders. I made a mental note and discussed." Sub-station Operator, Generation: "— smaller than what we use (but) if you need a low-voltage switch, GE has them. I discussed it and made a mental note." Manager, Top Management: "GE has this product, a spring-load, low-voltage breaker (that) can be operated manually or electrically. I made a mental note and filed the ad. We keep the magazines."

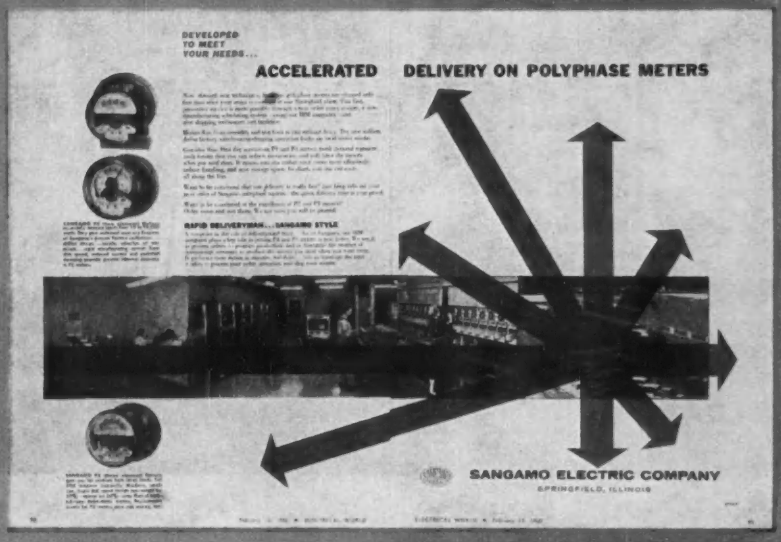
How ads start sales:

Reader verbatim comments from Mills Shepard "Penetration" studies of the Jan. 18 and 25, and Feb. 15 issues of Electrical World show sales action in the making.

★ This Line Material 2-color page found hot prospects everywhere. Asst. Purchasing Agent: "I sent for information and the factory brought a model out to show us." Technical Asst. to Vice President: "(This ad) gave me ideas on where and how it might fit into commercial sales, and I filed it. I have use for it as a suggestion to customers." Asst. to President: "I called the representative and he called on us." Operating Superintendent, Transmission & Distribution: "We think this is the answer to our load growth problems. I discussed it and plan to call the representative." Buyer, Purchasing & Stores: "We think this is a good idea and have considered them . . . I called the representative and discussed it."

from THIS.....to THIS.....or THIS!
New Developments Continue L-M Leadership in Underground Distribution Equipment
LINE MATERIAL Industries
Underground Distribution Headquarters

★ This striking red and black ad got across fast with its message of prompt delivery of Sangamo meters. Engineer, Transmission & Distribution Operations: "A better design that operates better under diversified loads. We feel it could be adapted to our system. I discussed it and referred it to someone." Division Meter Engineer: "I stopped to read the ad because this is my job. I made a mental note." Meter Superintendent: "Meters are my line. I look for these ads above everything else. I knew about these meters, but it was interesting to me to read the text . . . tells of a standardized meter and the fast delivery they can give us on this product. It would reduce costs by reducing the number of types and sizes in stock. The rapid service they offer can be a very helpful and money-saving factor."



Verbatim reader comments from Mills Shepard "penetration" studies show that an average of one out of every five readers interviewed *take some action* after reading an ad. The above are samples.

Note that some of these readers referred the ad to an associate, and some filed it. Some made a mental note, some discussed it, some called in a representative. And some even ordered the product. But most important, all did *something* that could make a sale a little easier for one of your men in the field.

And that, after all, is the purpose of businesspaper advertising — to inform, interest, and motivate the reader to action which can shorten the distance to the sale. The verbatims above are proof that this *can* be done — *is* being done consistently by companies that know the simple trick: Set forth the strongest sales argument you can muster, back it with facts, and publicize it in the most effective, economical medium you can hire.

That means Electrical World.

The electrical industry's weekly magazine

Electrical World 1st

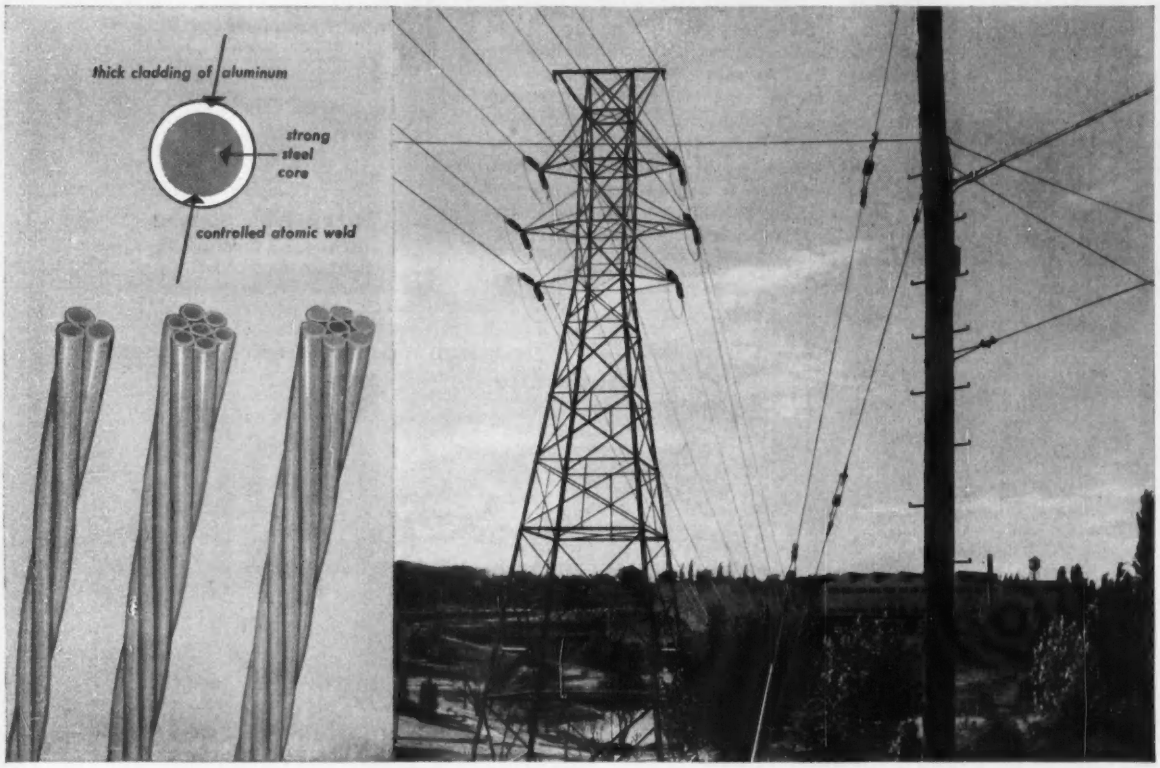
Covers the electric power industry completely

in service to advertisers
service to the industry
reader preference
utility circulation
total circulation
advertiser acceptance

A McGraw-Hill Publication, 330 West 42nd Street, New York 36, N. Y.

The Alumoweld technique *of welding aluminum to steel*

means TOP PERFORMANCE... LONG LIFE... LOW COST



• You cut costs and assure top performance of your overhead lines when you use Alumoweld for overhead ground wire, guys, messengers, and ACSR core wire • You'll have no maintenance worries because a thick cladding of pure aluminum permanently protects Alumoweld's high-strength steel core from corrosion. In fact, Alumoweld has the same corrosion resistance as solid aluminum wire—and 33% of the electrical conductivity. Compared to steel, Alumoweld has three times the conductivity . . . is 18% lighter . . . just as strong . . . and will last far longer.

For overhead ground wire, Alumoweld is tops. The high strength-to-weight ratio permits stringing with smaller sags, thus increasing the mid-span clearance. Its excellent conductivity quickly discharges lightning currents to ground—reduces service interruptions.

For guys and messengers, Alumoweld gives long, trouble-free life because it cannot rust. And it's strong and easy to install.

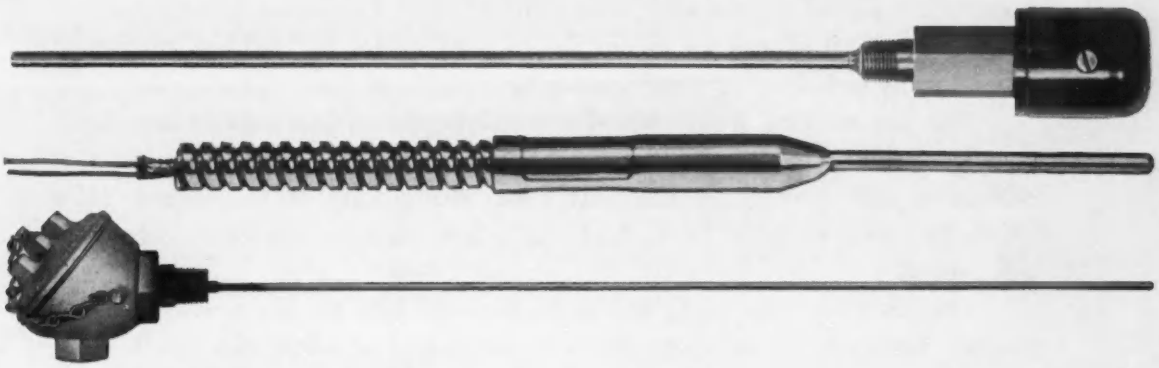
For core wire in ACSR Conductors, Alumoweld eliminates the danger of electrolytic action because it is compatible with solid aluminum wires. It coordinates the life of the strength members with that of the conductor members.

Get all the facts on this low-cost wire and strand by writing today for bulletin E.D. 3000.

ALUMOWELD

COPPERWELD STEEL COMPANY

CHOOSE FROM 150,000 STANDARD *MegopaK* SMALL-DIAMETER THERMOCOUPLES



If you've been looking for small-diameter, flexible thermocouples with high speed of response, search no more. You'll find exactly what you need in Honeywell's *MegopaK** line.

MegopaK is a combination of thermocouple wires, mineral insulation and a protecting sheath, compacted into a solid mass with a diameter as small as 1/16". You can get *MegopaK* in standard lengths up to 25 feet, and in lengths up to 50 feet on special order. They're available with copper-constantan, iron-constantan and *Chromel-Alumel*** calibration. In all, there are more than 150,000 standard combinations of materials and fittings. These top-quality thermocouples are supplied in bulk, and as elements with wires welded into a measuring junction, or as complete assemblies.

MegopaK assemblies come complete with terminations (heads, plugs, etc.) and mounting attachments. Also available are special configurations, tests, material and calibration certifications.

MegopaK thermocouples and other pyrometer supplies are stocked at our Los Angeles and Dallas depots as well as in Philadelphia to give you the fastest possible service anywhere in the country.

Check with your nearby Honeywell field engineer for complete details, or write for Catalog G100-4.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa. —In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

*Trademark, Minneapolis-Honeywell Reg. Co.

**Trademark, Hoskins Mfg. Co.

75th YEAR PIONEERING THE FUTURE

Honeywell

H HONEYWELL First in Control SINCE 1885

2170 SUBSTATIONS AND 40 YEARS LATER...

SOUTHERN STATES IS STILL LOOKING FOR THE MAGIC FORMULA

A great deal has been said about *standardized substations*. As much as we like the basic idea, the one thing we have learned is that there is no cut-and-dried, assembly-line, easy way to produce substations on an industry-wide basis.

We've been at it 40 years, producing more than 2170 substations of all kinds, and it has always been tough for us!

Even stations with essentially the same assignments have endless arrangements. Infinite combinations of design preclude standardization in the true sense of the word. The exception is where individual utilities have developed their own standardized substation programs. Otherwise substations must be virtually custom-made.

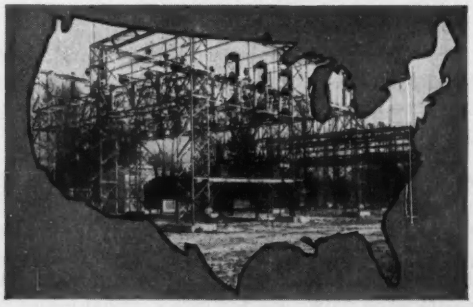
True, hundreds of designs in our files are helpful. Many standard components are picked up and used, with ultimate savings to our customers. And the years of practical experience of our design staff guides us, and our customers, around many pitfalls.

But you can't escape the fact that supplying substations requires these basic functions: skillful engineering, careful detailing, precise coordination of production schedules, and delivery on time. At least, that's what we've learned 2170 substations and 40 years later. And that's how we approach every substation assignment.

On this basis, you might like to do business with us. We'll welcome your inquiry. Just call your Southern States representative or write to us direct.

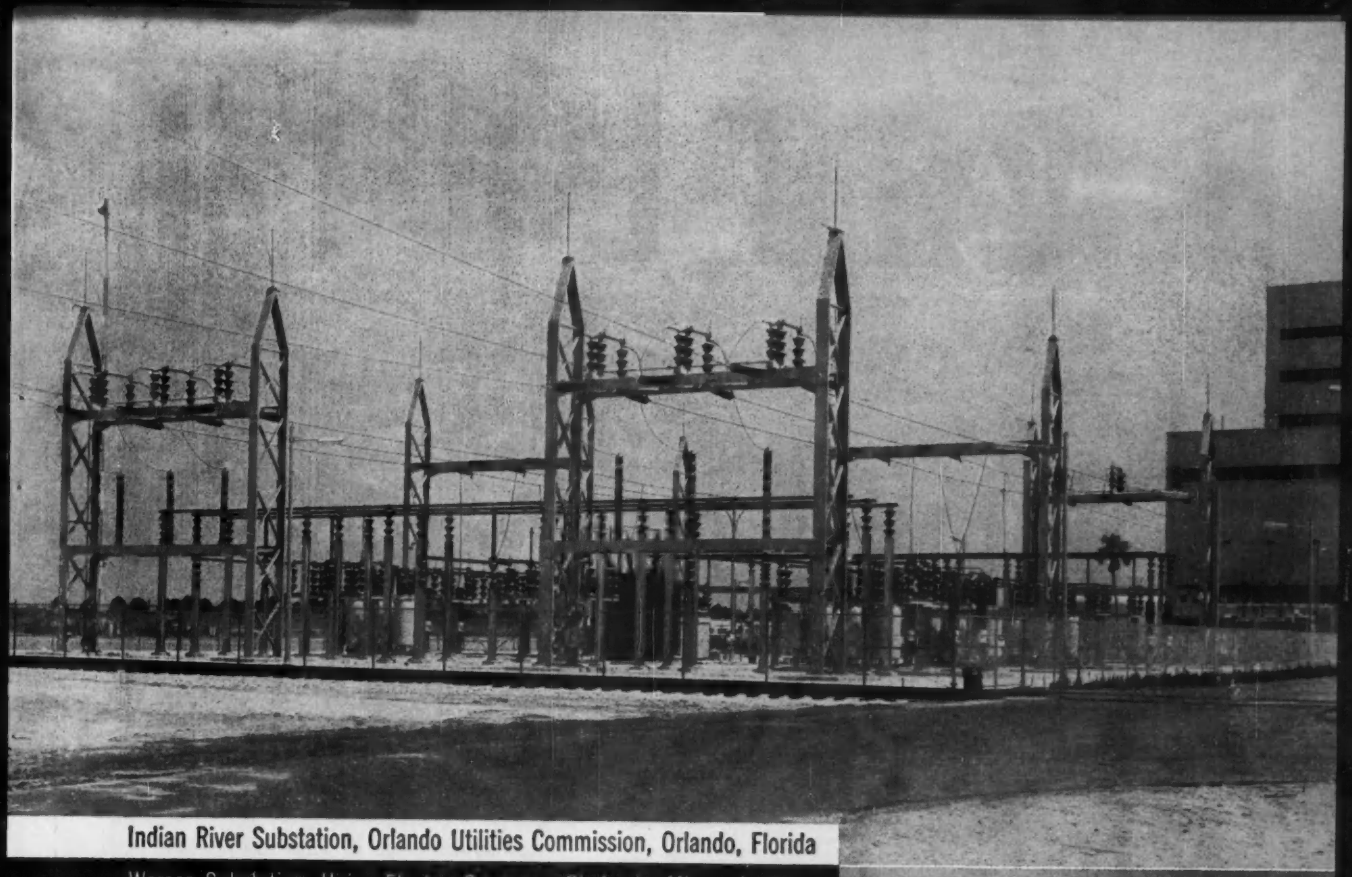
SOUTHERN STATES SUBSTATIONS ARE IN USE ALL OVER THE NATION

During the past 40 years Southern States has produced 2170 outdoor substations for hundreds of different customers. They range from small 5000 kva units to switchyards exceeding 1-million kva, and include substations for the nation's newest atomic systems. Regardless of size, Southern States scrutinizes every detail —from single-line wiring diagram to the finished station.



SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto



Indian River Substation, Orlando Utilities Commission, Orlando, Florida

Warson Substation, Union Electric Company, St. Louis, Missouri

BARTLETT

Years ahead in research and experience

FLEXIFIL

THE LOW-COST POLE REPAIR FOR WOODPECKER HOLES

Costly pole replacement can be avoided simply and effectively by filling the cavities with *Flexifil*. This easily applied compound which was developed by the Bartlett Research Laboratories to fill cavities in shade trees has approximately the same expansion coefficient as wood. It provides a permanent seal which is harder than wood, but it can be cut or sawed like wood. In addition to sealing the hole against inside damage, it restores that portion of the pole's strength and discourages further bird damage. If woodpecker holes are a problem, let us supply you with further information about Flexifil.

This is just one of many technical services we have developed for public utility companies. Bartlett research is carried on continuously, both at the company laboratories and through fellowships at various colleges.

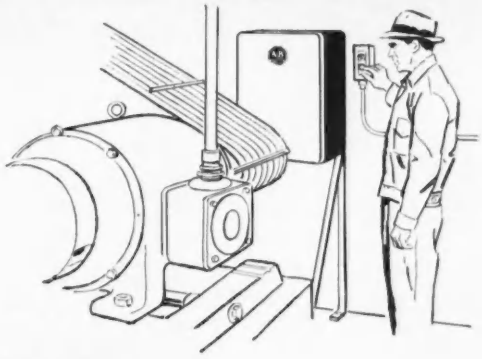
We invite you to share our background of years of public relations together with our extensive experience in tree surveying, helicopter spraying, line trimming, brush control and right-of-way clearance. This service is available from Maine to Florida and west to Illinois and Alabama.

BARTLETT

The Bartlett Way

TREE EXPERTS

Home Office, 2770 Summer Street, Stamford, Conn.
Research Laboratories and Experimental Grounds, Stamford, Conn.
Bartlett School of Tree Surgery, Stamford, Conn.

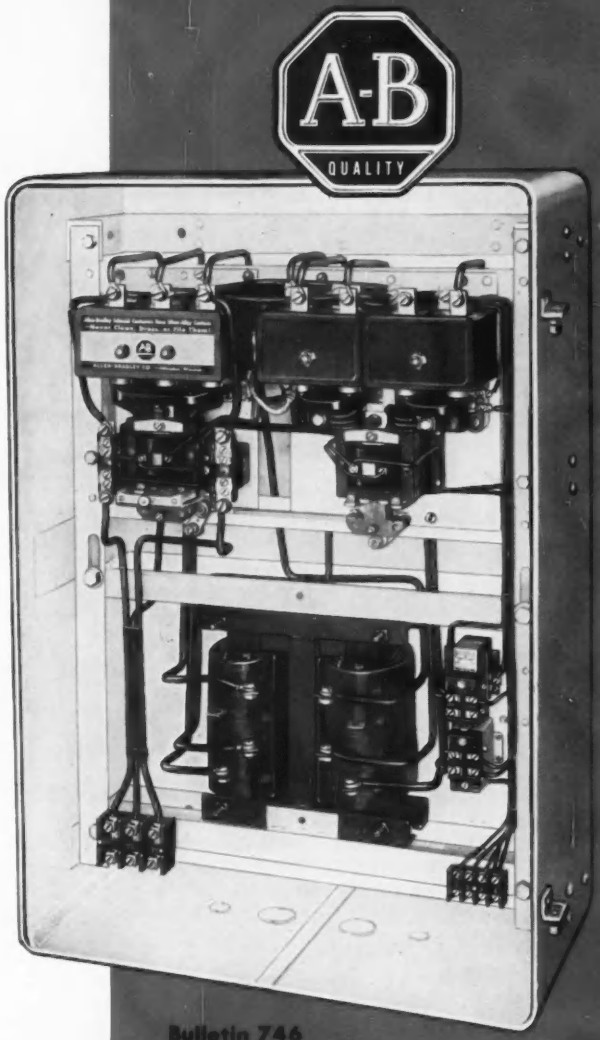


WHEN REDUCED VOLTAGE STARTING IS A MUST

Only Allen-Bradley can provide all the answers

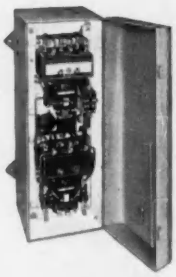
The Allen-Bradley line of reduced voltage starters makes possible a selection of the best starter, not only to meet the power company's requirements but also to provide the best starting conditions for the motor and the "load" that it drives.

The simple solenoid contactors in A-B reduced voltage starters have only ONE moving part—assuring millions of trouble free operations. And their double break, silver alloy contacts never need costly maintenance. Accurate, reliable overload relays protect motors against burnouts. Write for Publication 6088.



Bulletin 746

Automatic reduced voltage starter for squirrel cage motors that should not be started on full line voltage. It employs autotransformer connected in open delta to reduce line voltage during starting. Adjustable timing relay controls starting period. Taps are provided on the autotransformer to adjust the starting voltage applied to the motor. Ratings to 300 hp, 220 v; 600 hp, 440-550 v.

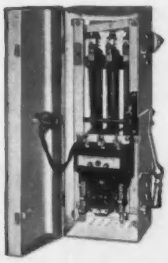


Bulletin 740

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting, and they are automatically cut out after a predetermined time. Turning a single screw on the starter frame adjusts the compression resistors exactly to motor and load conditions for velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.

Bulletin 640

Where remote control is not needed, these graphite compression disc resistor starters provide stepless acceleration of squirrel cage motors. Operated by hand lever, the smooth starting of the motor is under the control of the operator. No-voltage and dependable overload protection is provided. Ratings to 200 hp, 220-440-550 v.



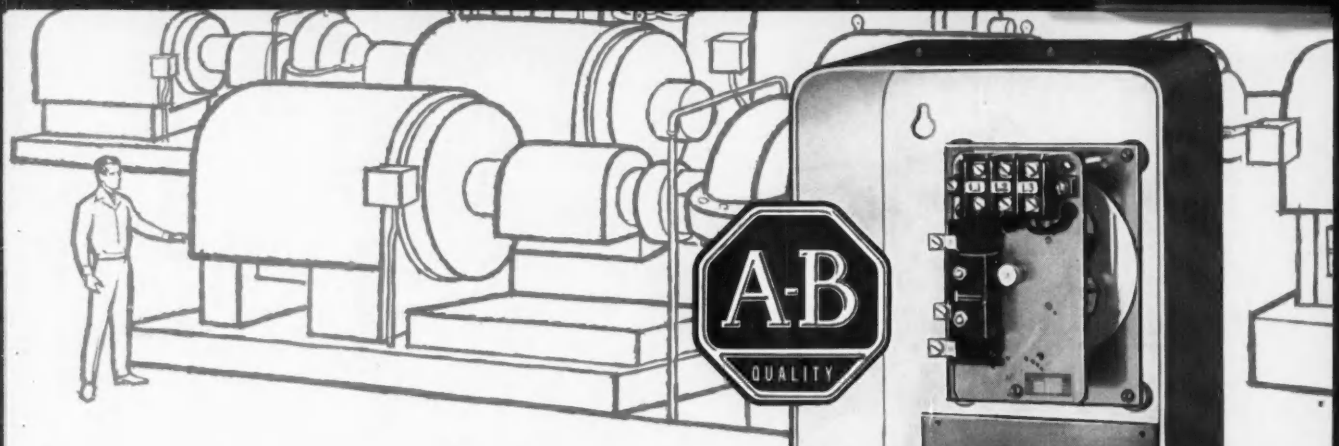
20-60-M

ALLEN-BRADLEY

Member of NEMA

Quality Motor Control

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



ALLEN-BRADLEY PHASE FAILURE *and* PHASE REVERSAL RELAYS

will provide positive protection for high-horsepower, high-priced motors!

It's sound "economy" to guard your investment in expensive motors and equipment against the extensive damage that can result from a phase failure or phase reversal. Allen-Bradley's Bulletin 812 Style RF relay provides *complete, positive* protection against both of these hazards.

The Bulletin 812 Style F phase failure relay instantly detects *all* open phase conditions on a motor branch circuit and removes the motor from the line—yet is not subject to nuisance dropouts from transient line fluctuations. An unusual feature of this Style F relay is its positive response, regardless of motor load or type of motor branch circuit employed.

The Bulletin 812 Style R phase reversal relay disconnects the motor from the line—whether it is running or not—when a phase reversal occurs on the line side of the relay. Thus, it can be used to protect a single motor or a group of motors. Furthermore, the Style R relay removes the motor from the line should a phase failure occur while the motor is stopped.

All A-B Bulletin 812 relays are completely "fail safe." It will pay you to investigate this economical insurance against the heavy losses that can—and *frequently* do—result from phase failure and phase reversal. Write today!

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
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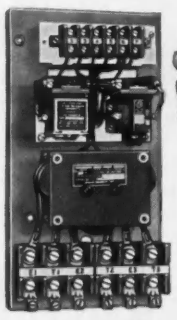
Bulletin 812 Style RF for Phase Failure and Phase Reversal consists of Style F Phase Failure and Style R Phase Reversal relays in the same enclosure.



Bulletin 812 Style F for Phase Failure

Bulletin 812 Style R for Phase Reversal

20-60-M

ALLEN-BRADLEY

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Quality Motor Control

New Wire and Cable Casebook

from Du Pont tells you why

THERE'S NO DOUBT ABOUT NEOPRENE JACKETING

DU PONT
Casebook
1
NEOPRENE a quarter century of service in the wire and cable industry
Earliest records of neoprene's use as a cable-jacketing material go back as far as 1933. Since then, this Du Pont synthetic rubber has more than proven itself in electrical installations throughout the world.
PROPERTIES AND APPLICATIONS OF NEOPRENE

CASE HISTORIES FROM A QUARTER CENTURY OF SERVICE

Utility engineers, electrical contractors and plant engineers will find the new *Wire and Cable Casebook* a valuable source of information. It documents neoprene's quarter century of service in the electrical industry, combatting weather, sunlight, aging, flame, ozone, corona, heat, oil, grease and mechanical abuse. Detailed reports of successful long-term applications . . . overhead and underground . . . show you why industry has put its confidence in neoprene-jacketed cable.

IMPORTANT PRODUCT NEWS

The new *Wire and Cable Casebook* will keep you up to date on the use of neoprene in switches, connectors, accessories and the many other important new products being developed for today's rapidly growing electrical industry.

FREE SUBSCRIPTION

Du Pont will send you the *Wire and Cable Casebook* free, four times a year. Take advantage of this new way to keep informed about neoprene, HYPALON® and the newer Du Pont elastomers. Fill out the coupon and mail it . . . *today*. E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department, Wilmington 98, Del.

PLACE YOUR SUBSCRIPTION NOW

EW-11

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DU PONT
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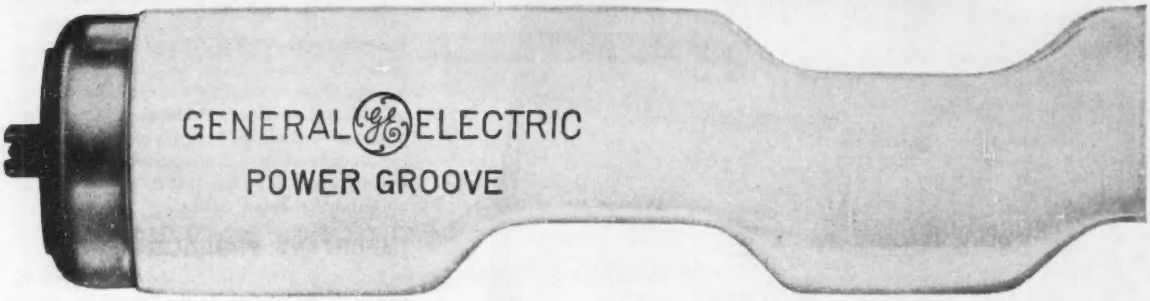
. . . through Chemistry

CUT INITIAL COST AS MUCH AS 40¢ PER SQ FT



It's easy with the most powerful fluorescent on the market! If you're planning a new building . . . or remodeling an existing one . . . you can shave your customer's initial lighting investment by as much as 40¢ a square foot!

How? Specify G-E Power Groove* Lamps. They give more light than any other lamp. You use fewer lamps, fewer fixtures, fewer everything else it takes to light your customer's building properly. And his savings keep mounting. With fewer lamps, fixtures and ballasts, his maintenance bills will be lower, too.

The secret's in the grooves. They're what bend the arc stream (it's straight in other fluorescents) . . . lengthen it . . . make the lamp put out more light. Only G-E Power Groove Lamps have 'em. Only General Electric gives you this years-ahead light source—another example of a difference that makes a difference in value to you. Call your G-E Lamp distributor for more information. General Electric Company, Large Lamp Dept. C-031, Nela Park, Cleveland 12, O.

*General Electric's trademark for configurated fluorescent lamps

Progress Is Our Most Important Product

GENERAL ELECTRIC

How a Co-op keeps power costs down with STANODIESEL Oil M

Engines operate 40,000 hours without overhaul

You expect more from STANDARD and you get it!

Pioneer Co-op's REA Plant supplies the electricity required by the 2,500 persons in and around the town of Ulysses, Kansas. Over the years, Pioneer's cost per kilowatt hour has been exceptionally low, thanks to the fine maintenance record of its four diesel power units and STANODIESEL Oil M.

No ring overhauls were required from 1948 until 1959, when the number one engine was taken down. The record: 40,095 hours of operation . . . 25,076,000 kilowatt hours . . . less than .006 inches of wear on rings and .005 on liners. All rings were free and there was very little deposit. And since operation began, Standard has supplied the Pioneer diesel oil requirements.

To find out how STANODIESEL Oil M can cut your maintenance costs contact the Standard Oil office near you anywhere in the 15 Midwest or Rocky Mountain states. Or, simply write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Inspecting the bearings from Pioneer's diesel engine number one are, right to left: plant superintendent Preston Turner, plant operators Arnold Davis and John Neese, Standard salesman W. I. Moon and Standard agent Eldred Bruntzel. Bill Moon is well qualified to help customers solve their lubrication problems. He graduated from Southwest Missouri State College with a degree in chemistry and has completed the Standard Oil Sales Engineering School.

Quick facts about

STANODIESEL Oil M

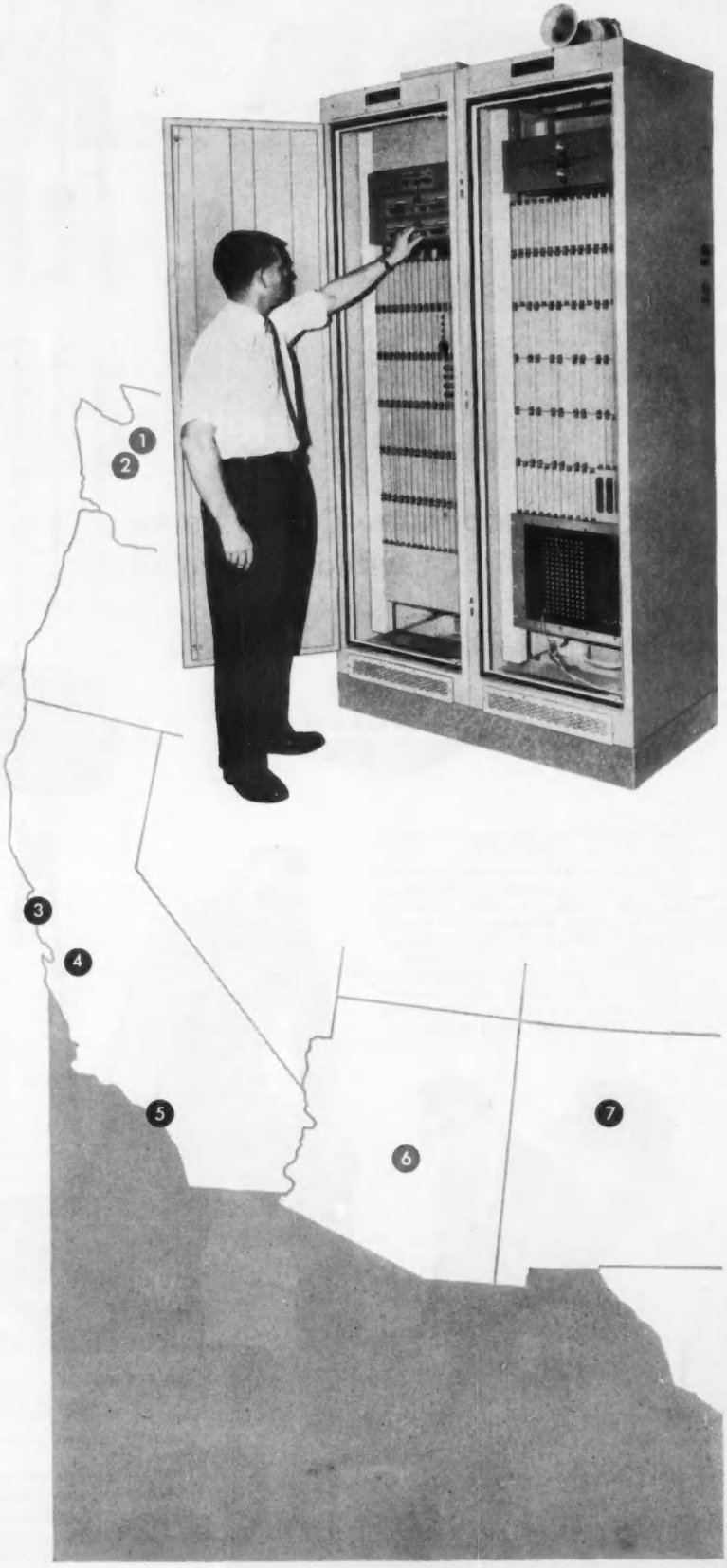
- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by economy fuels.
- Maintains film on difficult-to-lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.

KEY to functions performed by Bailey 700 Systems

A — Analog **A/D** — Analog and Digital
D — Digital **s** — sense and measure
d — display (indicate, record and/or log)
m — monitor (scan and alarm)
p — produce stored information for future use (tape, cards) **c**—compute **r**—control

● Installed ● On order

LOCATION	TYPE	FUNCTIONS
1. Chelan Co., Wash.	D	sdm
2. Chelan Co., Wash.	D	sd
3. San Francisco	A	sdc
4. Salinas, California	A	sdc
5. Los Angeles	A	sdc
6. Glendale, Ariz.	A	sdc
7. Alameda N. M.	A	sdc
8. Amarillo, Texas	A/D	sdmc
9. Smithers Lake, Tex.	A	sdr
10. Orange Co., Tex.	A/D	sdmcr
11. Bronte, Tex.	D	sdm
12. Sioux Falls, S. D.	A	sdr
13. Oklahoma City	A	sdc
14. Harrah, Okla.	A	sdc
15. Muskogee, Okla.	A	sdc
16. Lafayette, La.	A	sdc
17. Jackson, Miss.	A	sdc
18. Cleveland, Miss.	A	sdc
19. Memphis, Tenn.	D	sdm
20. Paducah, Ky.	D	sdc
21. Sullivan, Ind.	A	sdc
22. Graham, W. Va.	A	sdc
23. Ashtabula, Ohio	A	sdc
24. Monroe, Mich.	A	sdcr
25. Rochester, N. Y.	A	sdc
26. Ludlowville, N. Y.	D	sdmp
27. Buchanan, N. Y.	A	sdr
28. Fairless Hills, Pa.	D	dm
29. Wilmington, Del.	D	dm
30. Washington, D. C.	D	dp
31. Hamilton Twp., N. J.	A	sdr
32. N. S. Savannah	A	sdr



BAILEY 700

ANALOG AND DIGITAL SYSTEMS IN ACTION

Installed or under construction, Bailey 700 Analog and Digital Systems are IN ACTION TODAY from coast to coast, providing integrated instrumentation systems accurately tailored to specific needs.

Note the variety of functions performed in these installations. Basic ingredients of all are electronic modules housed in standardized electrical cabinets, as shown here. This permits any combination of control, information or computing system elements to be combined and expanded as required to perform specific functions in individual installations. Wiring and maintenance is simplified —operator's console is freed of bulky equipment.

Ask your local Bailey engineer to arrange a visit and demonstration of a Bailey 700 System located near you, or at Cleveland. Or get IMMEDIATE details on the installation of greatest interest to you, by TWX—just jot down the number of the location you select on message form below and hand to your secretary. Reply will be transmitted at end of your message.

G153-2

QUICK FACTS BY TWX . . .

For name and IMMEDIATE details on installation of greatest interest to you, fill in number of location from map and have your TWX operator send this message:

WKLF 522

PLS SEND 700 SYSTEM DETAILS FOR LOCATION_____. PROCEED IMMEDIATELY WITH REPLY AT CONCLUSION OF THIS MESSAGE.

Name_____ Title_____

Company_____

City_____

Instruments and controls for power and process

BAILEY METER COMPANY

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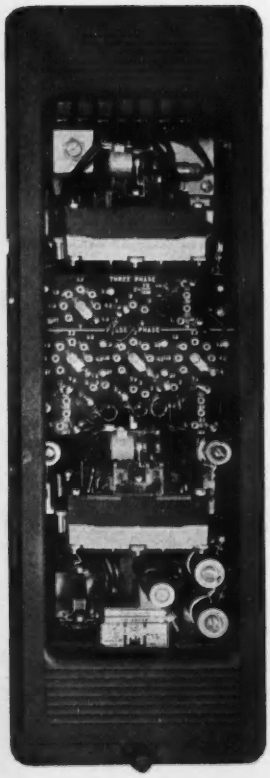
In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

NEW

Westinghouse KD-CO relay system offers unmatched protection for subtransmission and distribution lines

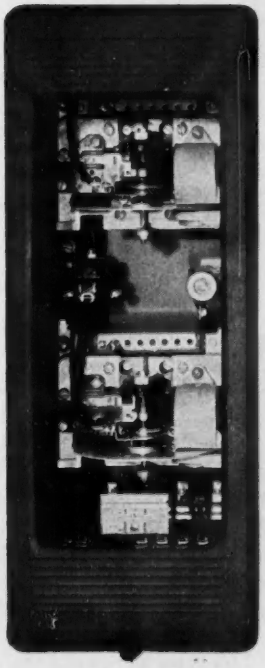


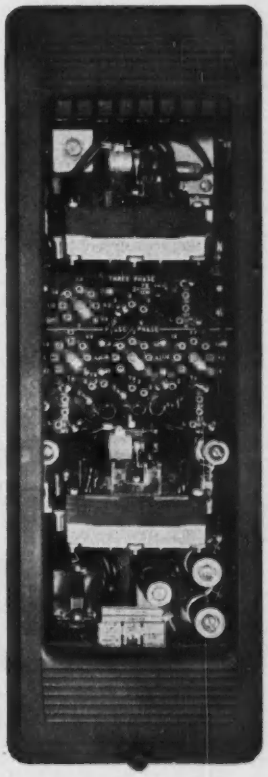
For the first time, this new Westinghouse relay system permits the exact fixing of the distance of overcurrent protection along the line and offers complete directional distance torque-control. Three standard Westinghouse Flexitest* cases enclose the whole scheme, neatly and compactly. You enjoy the assurance of dependable performance established by the famous semi-static K-Dar units. These are completely standard KD relays, used in conventional zone and carrier relay systems.

Call your Westinghouse sales engineer for more information about this new advance in protective relaying or write for RPL 60-14, Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. You can be sure . . . if it's Westinghouse. J-40534

*Trade-Mark

Two standard KD relay units and one two-unit CO timing relay comprise the complete package. Note how neatly and compactly they work together in standard Westinghouse Flexitest cases.

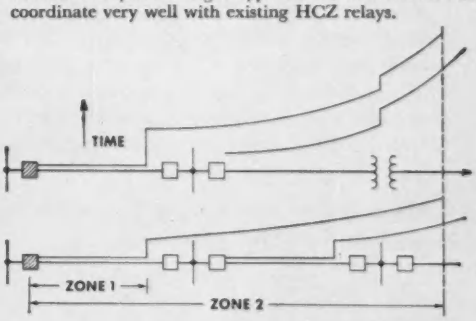




Here's how it works:

One KD is set for 90% of the line for instantaneous primary first zone protection. The other KD is set into or through the remote adjacent line for end zone primary and remote back-up protection. This KD is also used to torque-control the double-unit CO relay which is used as a timing relay for selective tripping. The overcurrent sensitivity can be set below load since its operation is controlled by the KD relay. The KD relays can be set into or through the transformer bank for full protection on either side of the bank.

It's worth noting, too, that various overcurrent time characteristics can be used to coordinate with existing relays . . . Types CO, CR, HRZ or HCZ. For example, the KD-CO system using a Type CO-7 characteristic will coordinate very well with existing HCZ relays.



Typical application for two-zone KD relaying with two-unit torque-controlled Type CO relay for zone-two timing.

Westinghouse

CRESCENT HOT LINE GRIPS

FOR SAFE, REMOTE OPERATION WITH HOT LINE STICKS

▶ These grips are an adaptation of the standard Crescent Grip which has earned a reputation with line crews everywhere for being jamproof, slip-proof and instantly releasing.

Operation is simple for linemen familiar with the use of hot line sticks. Grip is held open by engaging notch "B" in bottom of frame loop. Grip is then placed on wire by means of eye "A". Latch "D" is swung into place with hot line stick. Jaws are closed by action of spring "C" when engagement of notch "B" is tripped by upward movement of the pulling eye arm. Grip is released by placing hot line hook on rivet stud "E" and pulling until notch "B" engages frame loop.

Made in three sizes; each grip tested to its safe load capacity. Cadmium plated.

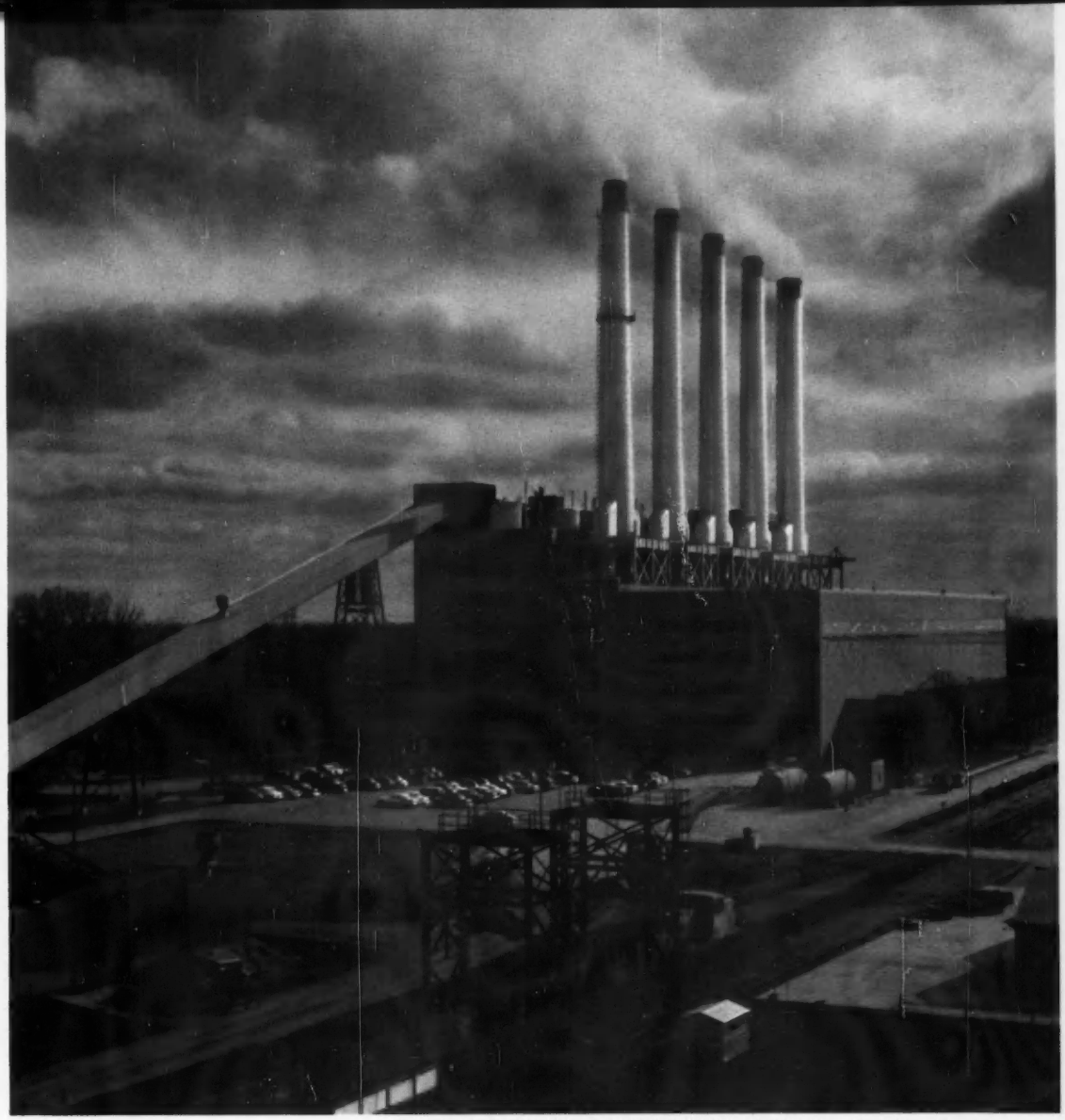
SPECIFICATIONS

SERRATED JAWS	MAXIMUM CAPACITY	MINIMUM CAPACITY
No. 383 HL	5/16 (.3125)" 8 mm	5/32 (.156)" 4 mm
No. 384 HL	1/2 (.500)" 12.2 mm	1/4 (.250)" 6.5 mm
No. 385 HL	3/4 (.750)" 19 mm	3/8 (.375)" 9.5 mm

No. 383-2 HL, 384-2 HL and 385-2 HL same, except with smooth jaws for bare aluminum wire.

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK



WABASH RIVER STATION PUBLIC SERVICE COMPANY OF INDIANA, INC. *585,000 kw—6 Units*

Power in Indiana...

Wabash River Station, a mine-mouth plant, is an example of the rapid growth of the facilities of Public Service Company of Indiana, Inc. Since 1939 the company has authorized 1,500,000 kw of new capacity. The newest plant at New Albany, Indiana has four 150,000 kw units, the last of which is scheduled for operation in early 1961. Design for these generating facilities, as well as for major substations and transmission lines, has been performed by Sargent & Lundy.

FULL COLOR BROCHURE outlining the scope of Sargent & Lundy services will be sent on request.

SARGENT & LUNDY
ENGINEERS

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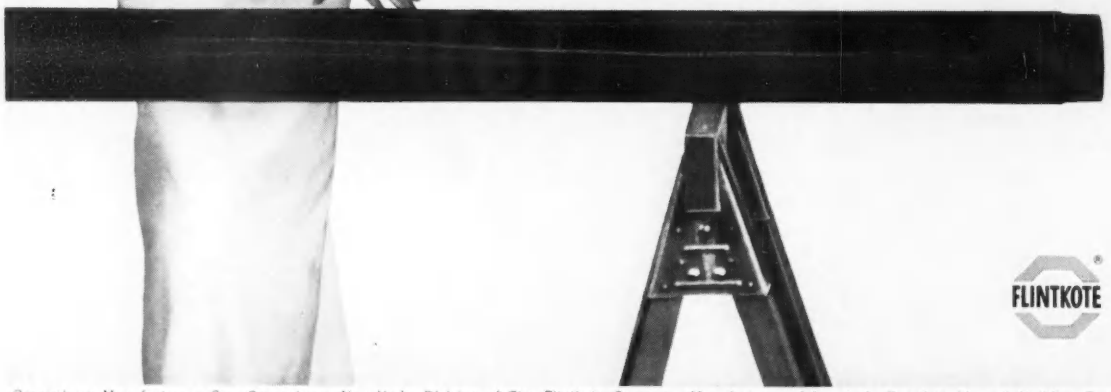
Announcing an exclusive new development in fibre conduit

A development of Orangeburg and Flintkote Research Laboratories, new *klean-kote* Orangeburg Fibre Conduit has a tough, non-brittle protective coating for cleaner, safer handling. To you and your men, this literally means cleaner hands, cleaner clothes and little or no chance of irritation. In addition, new *klean-kote* travels better, weathers better—and makes a stronger-than-ever joint.

Nothing has been changed in the traditional fine quality of the Orangeburg product. New *klean-kote* is just what the name implies — *a clean coating.* Beneath it lies the same quality product, manufactured with the same painstaking care which has made Orangeburg the best-known, best-selling line in America. Ask your wholesaler to show you a length of new *klean-kote* Orangeburg now.

Cleaner hands Cleaner clothes No irritation

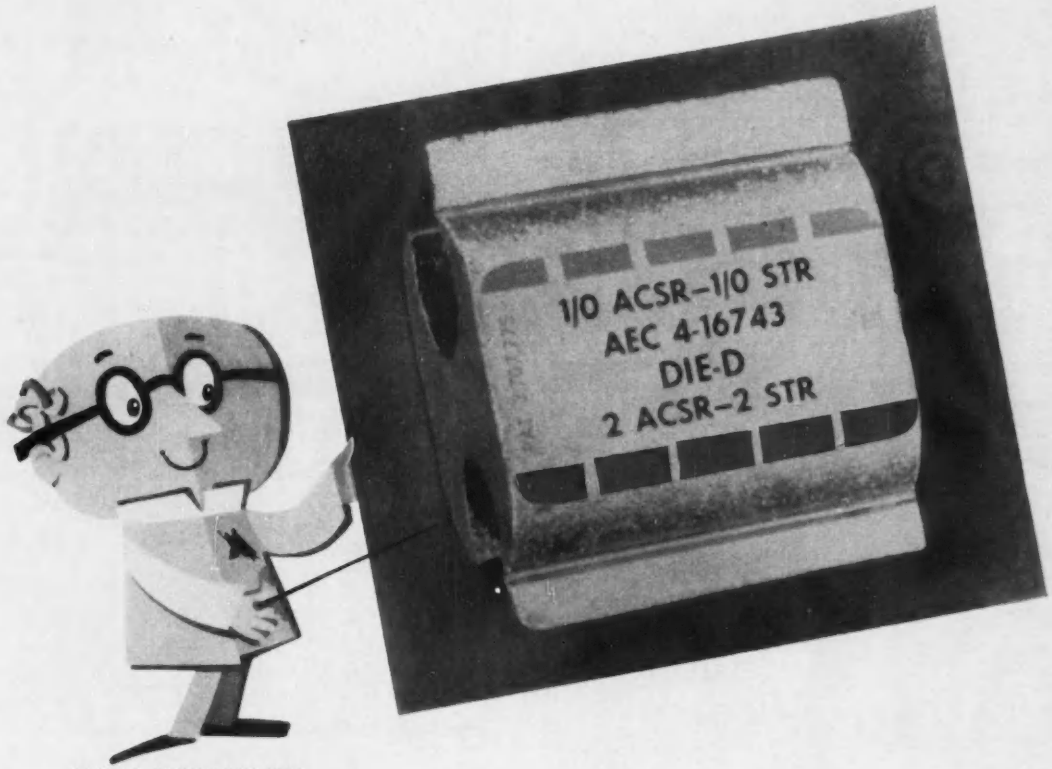
**klean-kote*
ORANGEBURG®
Fibre Conduit**



FLINTKOTE®

Orangeburg Manufacturing Co., Orangeburg, New York. Division of The Flintkote Company, Manufacturer of America's Broadest Line of Building Products

*KLEAN-KOTE IS A TRADE-MARK, U. S. PATENT APPLIED FOR. ORANGEBURG KLEAN-KOTE IS DISTRIBUTED BY GRAYBAR ELECTRIC CO. AND GENERAL ELECTRIC SUPPLY CO. WITH BRANCHES AND STOCKS IN PRINCIPAL CITIES



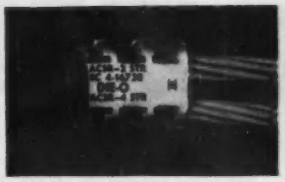
ANDY ANNOUNCES

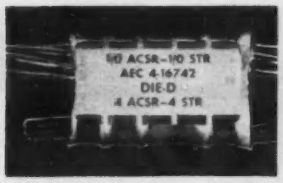
New COLOR-CODED double-tab *Dura SQUEEZE*

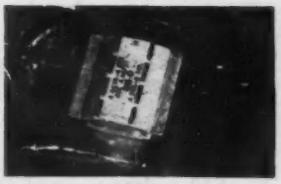
Aluminum Parallel Compression Connectors

New from Anderson! Exclusive marking system on the CPH *connector itself* quickly indicates proper connector to be used with conductor. Color lines also indicate the number and location of crimps.

Anderson CPH series takes the "ups and downs" out of parallel compression connectors, too. CPH's are *reversible* . . . either groove can be used for main or tap. Fewer sizes do the whole job better . . . and easier. Holding tabs keep the conductor and fitting in place while being compressed.







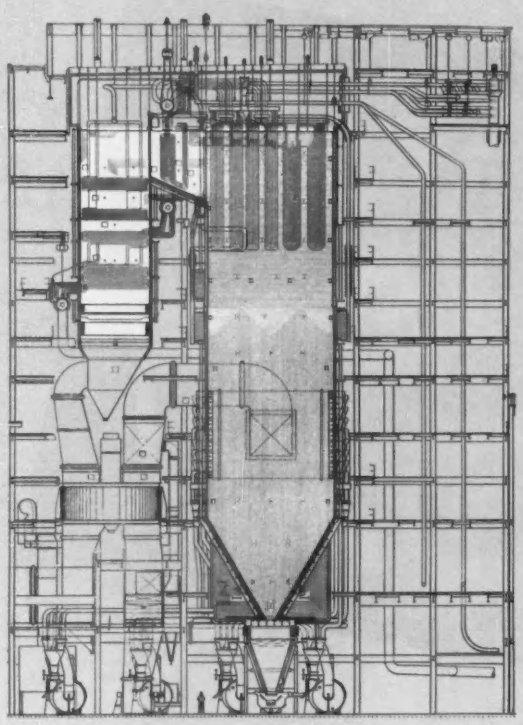
LOOP DEADENDING (left) No threading through the fitting . . . just loop wire, install Dura Squeeze, and crimp. ■ **EXTRA PROTECTION (right)** Grooves are spaced to prevent galvanic action between dissimilar conductors. Compressed connector "holds fast," to keep cable strandings in original relationships, provide equal contact pressures, increase load-carrying capacity.

HEADS OR TAILS . . . YOU WIN (left) Reversible CPH allows either "step up" or "step down" tap connections. ■ **"EZY TEAR" PACKAGE PRE-INHIBITED GROOVES (right)** Factory inhibited connectors are packaged in individual, easy-to-open plastic bags for maximum protection, minimum installation time.

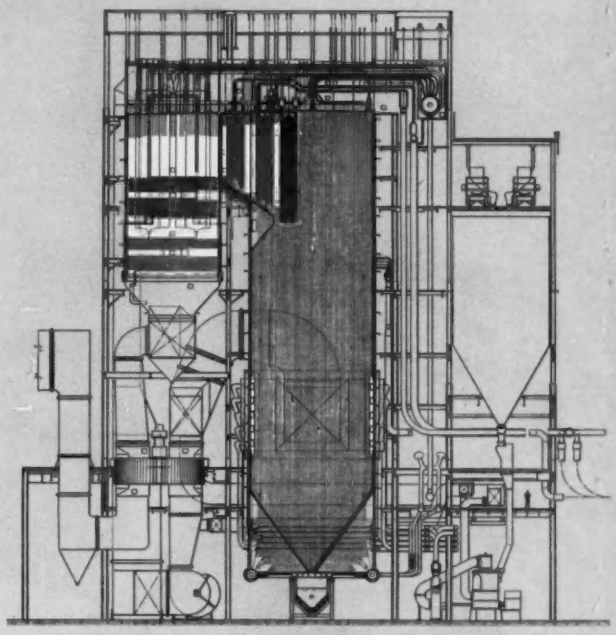
P. O. DRAWER 2151
BIRMINGHAM, ALABAMA

ANDERSON ELECTRIC

Research / Quality / Performance / in Aluminum and Bronze Products



The unit pictured here represents the most advanced power plant cycle yet attempted. This boiler, a C-E Sulzer Monotube Steam Generator, is designed to deliver 1200 F steam at a pressure of 5000 psi to a 325-megawatt turbine-generator. The unit employs a double reheat cycle (1050 F—1050 F) and has a primary steam flow of 2,000,000 lb per hr. It went on the line in February, 1960.



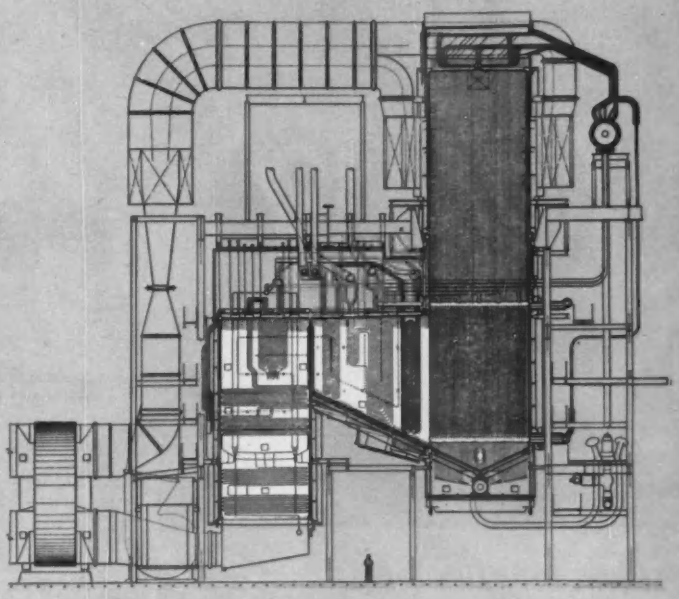
This boiler, a C-E Controlled Circulation unit, serves the world's first 500-megawatt turbine-generator. Designed for a primary steam flow of 3,850,000 lb per hr, it delivers 1050 F steam (1000 F reheat) at 2450 psi. It was placed in service in 1960.

PROFILES

In 1950, a decade ago, Combustion installed some 40 utility boilers, representative of the complete range of power practice at that time. The average turbine capacity was 50 megawatts . . . the largest, 120 mw. All boilers were of natural circulation design, only two used reheat, only two had design pressures as high as 1800 psi. By contrasting these statistics with those of the boilers shown above, the length of the strides taken in the last ten years can be more fully appreciated.

A broader picture of current practice is revealed by the following data relative to 1960 C-E utility installations, which will serve nearly 4,000 mw of new capacity. Six of these boilers will power turbines of 225 mw and above, the largest serving a 500-mw turbine. All but two are designed for pressures in excess of 1800 psi . . . all employ reheat . . . about 60 per cent are of Controlled Circulation design. More than 70 per cent of the units serve turbines with capacities from 150 mw up. In fact, the average unit size is more than three times that of ten years ago, and the largest has

Shown here are three C-E boilers, each of which represents an advanced design concept. Their major points of difference concern capacities, cycles, configurations — considerations of major import in the industry's continuing effort to keep power costs down. As indicated by the picture captions, one unit (far left) is the world's highest pressure boiler and represents the most advanced and efficient cycle yet attempted in power plant practice. Another (left) is the world's largest boiler, serving the first 500-megawatt turbine-generator to go into service. Both of these units went "on the line" in 1960. Although different in design, both follow the same general pattern which has long been characteristic of large C-E utility boilers. The third boiler (right) represents a marked departure from this classic arrangement. Because of the flexibility of its C-E Controlled Circulation design, heating surface can be placed in almost any desired position. Thus, it becomes possible to effect sizable savings in structural steel, stairs, platforms, piping, earthquake-proofing, as well as in the boiler itself.



This new look, made possible by the flexibility inherent in C-E Controlled Circulation design, holds much promise of bringing new first-cost economies to power plant practice. This reheat boiler is designed to deliver 1050 F steam (1000 F reheat) at 2400 psi to a 300-megawatt turbine-generator. It has a primary steam flow of 2,305,000 lb per hr.

# of Power Progress

over four times the capacity of the biggest unit of 1950.

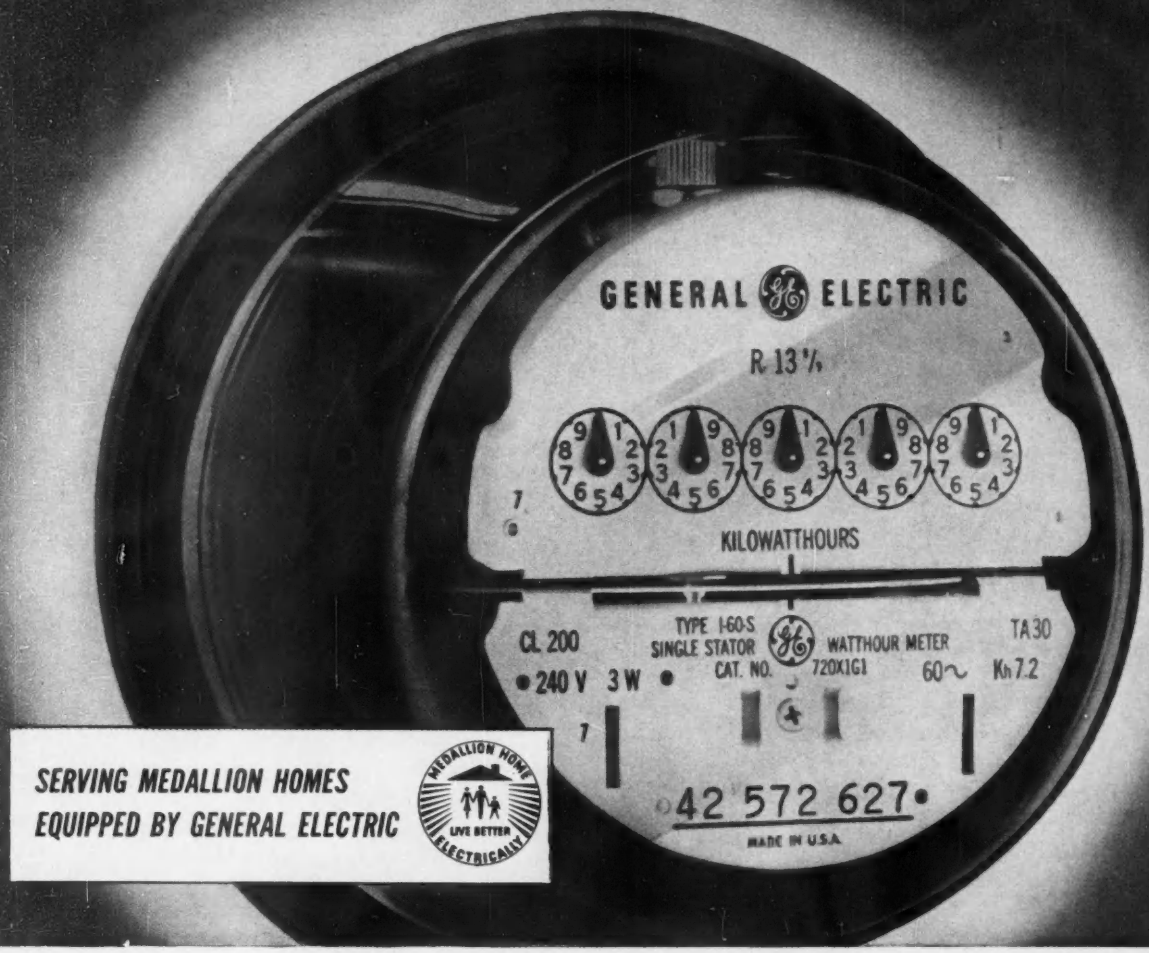
During the last decade, the vocabulary of the power plant has been enlarged with the addition of such words and phrases as "skin casing," "divided furnaces," "twin furnaces," "panel wall," "welded wall," "subcritical," "supercritical," "platens," "pressurization." They account, in large measure, for the fact that, while generating costs have risen considerably over the last ten years, the average net production cost per kw-hr is substantially less today than it was in 1950.

COMBUSTION ENGINEERING

C-298

General offices: Windsor, Connecticut
New York offices: 200 Madison Avenue, New York 16

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



Today's purchase of each General Electric I-60 provides . . .

Up to 83¢ in EXTRA VALUE by

Each General Electric single-phase meter with magnetic suspension put in service today can save you up to $0.83 in present worth, $1.98 in gross maintenance costs over 15 years . . . here's proof:

Ball bearings in ordinary meters wear, causing loss of accuracy and revenue. Replacement—in a comparatively short time—is necessary for efficient, economical operation. *Bearing replacement is costly.*

Here's a typical example. Assume replacement occurs after 15 years' service. Then, consider these replacement maintenance costs: $0.90 per meter, net cost for parts; $0.33 per meter, average labor cost; $0.75 per meter, average cost for handling and recalibrating. *These replacement costs total $1.98 per meter.* Using a present worth factor of six percent interest for each of the 15 years, the conservative cost of bearing replacement on each ball-bearing meter would be $0.83.

General Electric single-phase—and polyphase—meters with magnetic suspension have *no bearings to wear out or replace*—no measurable bearing wear after the equivalent of 300 years of normal service. In fact, of nearly 12,000,000 G-E magnetic suspension meters now in service, not one has ever been replaced because of bearing wear. This is proved reliability.

Now, multiply the $0.83 figure calculated by the number of ball-bearing meters you have in service . . . and see why, *in metering, anything less than the best is too costly.*

For additional information, contact your General Electric Sales Engineer. Or write General Electric Co., Somersworth, N. H. 713-03

In metering, anything less than the best is too costly

Present Worth Savings From No Bearing Wear

TOTAL EXTRA VALUE 83¢
NET COST FOR PARTS 90¢
33¢
HA ING AND CALIBRATING 75¢
$1.98
No Bearing Wear With Magnetic Suspension
Cost To Replace Each Bearing System

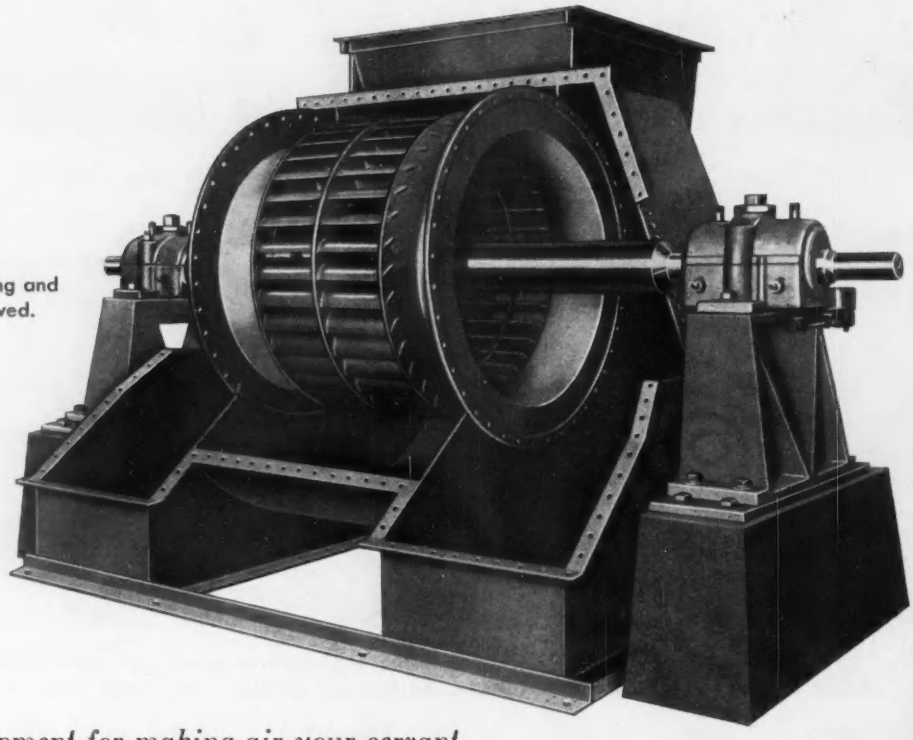
Eliminating Bearing Replacement

METER DEPARTMENT

GENERAL ELECTRIC

CLARAGE

HAS WHAT IT TAKES for induced draft, toughest fan service of them all! The Clarage Dynacurve Fan is built extra heavy for extra service life. Compact design minimizes floor space and height requirements. Rugged wheel has 36 radially deep, aerodynamically curved blades and tapered rims. Optional wearing plates go where they belong—on the **face,** not the back, of the blades. Optional scroll liners are **bolted,** not welded, for easy replacement. Save cost, save space. Choose Clarage.



Sections of housing and inlet boxes removed.

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richlieu St., Montreal

29 units, 1½ million Kw controlled by new L&N computer

"The only thing wrong with this computer is the fact that we didn't have it 10 years ago."

The comment comes from John Witman (left) Superintendent of Titus Station, Metropolitan Edison Company, Reading, Pa.—a member company of General Public Utilities. Witman, who has had a year's experience with his new L&N control, is shown here with F. Stewart Fehr, Project Coordinator of the GPU Automatic Lambda Dispatch System.

The computing unit shown here at Titus receives a station "cost" signal as telemetered from an L&N computer located at the Central Dispatching Office in Reading. The console converts this cost signal into unit control signals in order to maintain each Titus unit at its lowest cost-of-delivered-power output at all times. Similar consoles keep 29 units of the General Public Utilities' companies operating at the lowest overall cost.

Maintenance—a natural question where computer-controls are concerned—has been at a minimum. Installation of the equipment was made without difficulty—and on schedule. Operators have learned to use the system easily, in many cases with no more than a single, formal training session. Because men at the generating stations are relieved of the minute-to-minute problems of keeping units economically loaded, they can perform their other duties more efficiently.

When you make your decision regarding computer control for automatic dispatch or for any power plant control system—remember that when you specify a precision L&N system, you are specifying the *best* protection available for generating equipment whose dollar value may be 100 times that of the control itself. As operators on so many L&N-controlled systems have discovered, quality doesn't cost—*it pays.*

For details contact your nearest L&N Field Office, or 4938 Stenton Ave., Philadelphia 44, Pa.

LEEDS & NORTHRUP • *Pioneers in Precision*

Developed by SANGAMO

to meet your power capacitor needs . . .

SELCOVAR 50s - 100s

EXTRA small in size
EXTRA light in weight
EXTRA low in watts loss

W. J. Thacker, Manager, Power Capacitors and Controls, displays Sangamo's newest contribution to the utility industry . . . SELCOVAR 50's and 100's.

The new Sangamo 100 kvar capacitor is 14 to 19 percent lighter—21 to 24 percent smaller than other 100 kvar capacitors on the market today. A new low-loss kraft paper dielectric combined with Sangamo design and manufacturing methods enables low losses, low dielectric temperature and exceptional stability.

Use of the same design advantages in the 50 kvar unit substantially reduces its weight and size, and results in a unit with 15 percent lower watts losses over an extended temperature range.

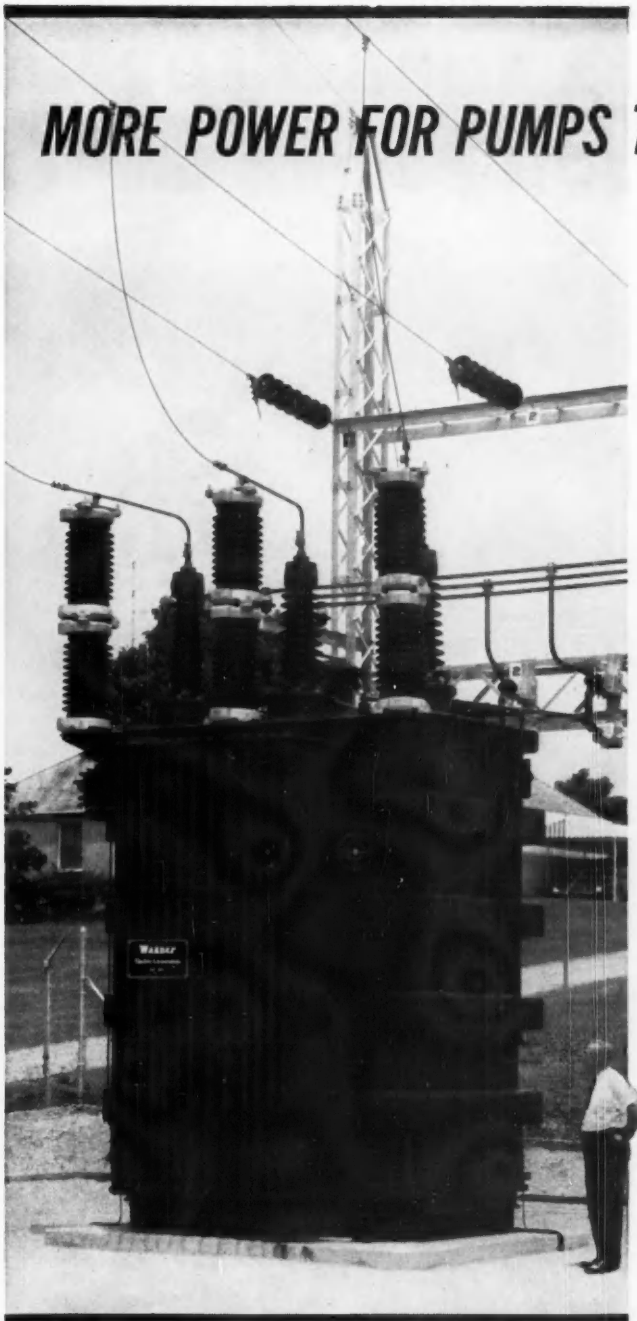
Pole type and stacking unit equipments are available with these new Selcovar 50 and 100 kvar capacitors.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

PC 60-3

MORE POWER FOR PUMPS THAT PUSH PETROLEUM



THIS WAGNER TRANSFORMER

POWERS-UP

PLANTATION PIPELINE

The Plantation Pipeline Company pumping station at Neese, Georgia, is part of an underground transportation system that pushes high quantities of petroleum products to their market.

The Neese operation was originally served with power from a 44 kv system substation. However, the size of the pumping load—which includes some 1800 hp motors—became too great for the substation to handle adequately.

To better serve the load, Georgia Power Company recently installed a 110 kv line and built a new substation. Wagner Electric Corporation furnished the transformer rated at 7500 Kva for this purpose. Today, Plantation Pipeline pumps with full power.

Now, what about your power needs? If they present a critical (or even a potential problem), call your nearby Wagner Sales Engineer. He'll help you plan your power program . . . suggest Wagner transformers that will meet your needs for years to come. There are Wagner branches in 32 principal cities.

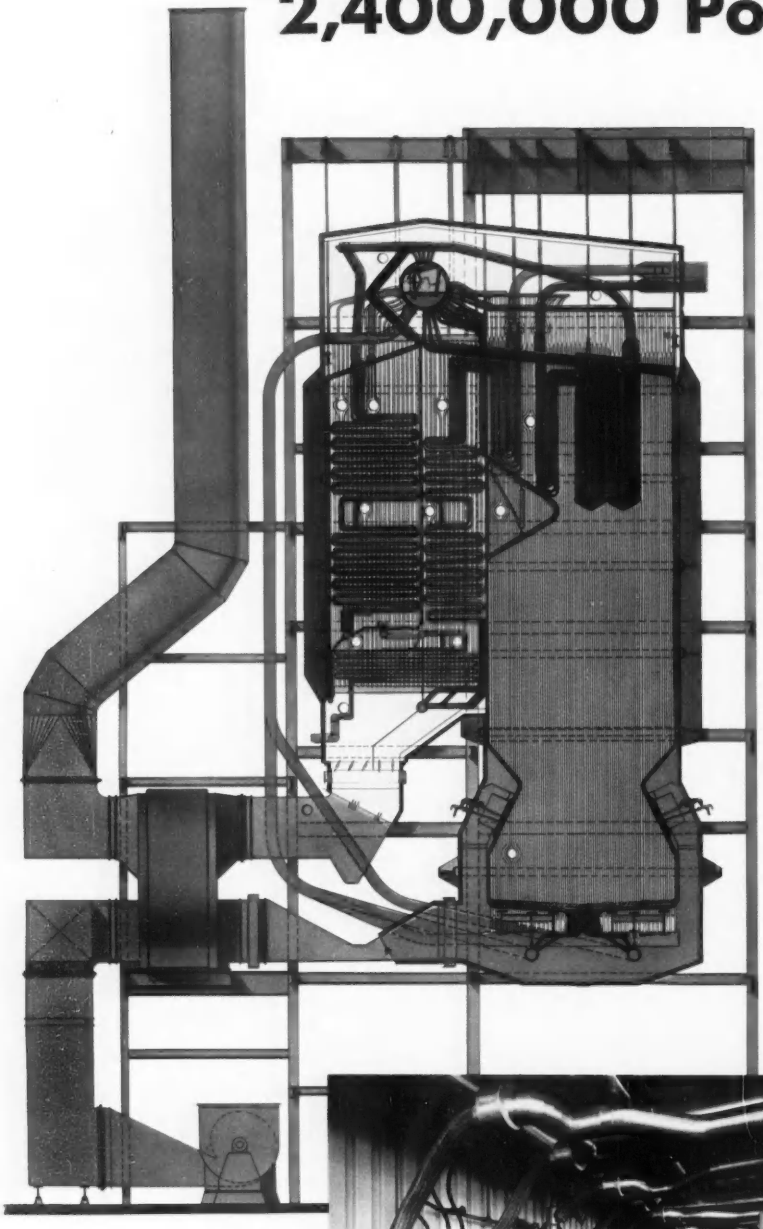
Wagner Electric Corporation

6456 PLYMOUTH AVENUE,
ST. LOUIS 33, MISSOURI

WT60-8

SERVING 2 GREAT GROWTH INDUSTRIES—*ELECTRICAL • AUTOMOTIVE*

Two RILEY TURBO FURNACE 2,400,000 Pounds of Steam



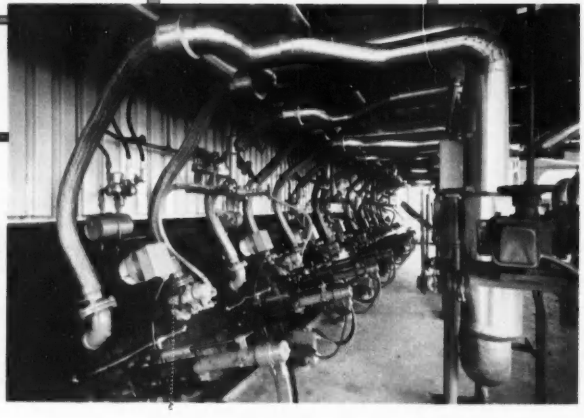
At the new North Lake Steam Electric Station the first of two Riley Turbo Furnace Reheat Boilers recently purchased by Dallas Power & Light Company is now on the line. Distribution of furnace gases is exceptionally uniform with minimum metal temperature variations across the full widths of reheater and superheater. Superheat and reheat temperatures are maintained over required control ranges. Boiler operates continuously at design rating for long periods. Extreme ease of operation with minimum operating personnel results from all burners being located for opposed firing on *one* level. Steam temperature is mainly controlled by automatic dampers located below the economizers.

Several other Southwestern Public Utilities have installed the Riley Turbo Furnace Boiler because its design and method of firing permits quick, easy and low cost conversion from natural gas to other fuels.

ENGINEERING DATA

Capacity — 1,200,000 lbs/hr
Pressure — 2125 psig
Superheat — 1005F,
Reheat — 1005F
Fired by Natural Gas, Oil

EBASCO SERVICES, INC.
Consulting Engineers

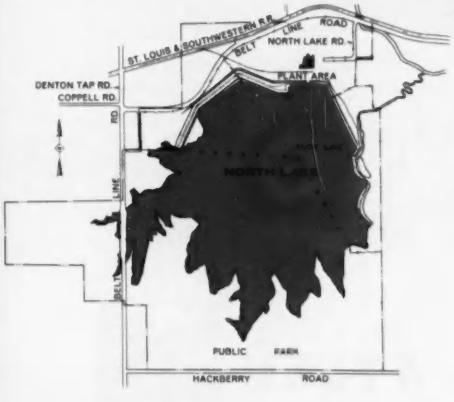


One of two firing aisles located on opposite sides of the furnace shows ten Riley Directional Flame Turbo Furnace Burners. The Turbo Furnace single level burner arrangement minimizes operating supervision and maintenance.

A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

Reheat Boilers will produce for *Dallas Power & Light Company*

NORTH LAKE STEAM ELECTRIC STATION



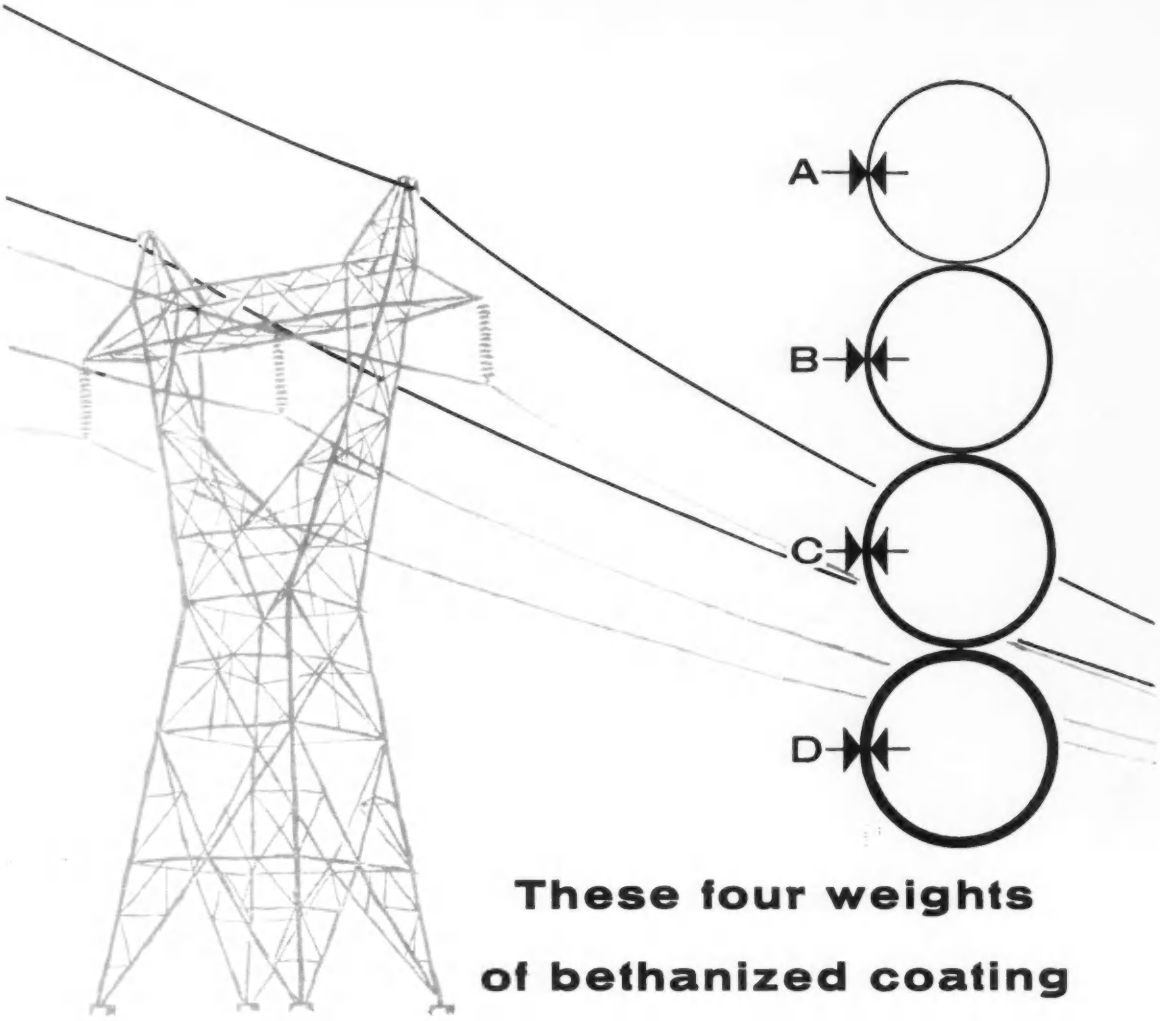
North Lake is an 800 acre man-made lake constructed for cooling water by Dallas Power & Light. Most of its area is open to public boating and fishing. Here is an unusual use of a private power company's facility. Much credit is due to Dallas Power & Light Company for imaginative and public spirited foresight.

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT

RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS.

Sales Offices:
Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, St. Louis, St. Paul, Seattle, Syracuse.



These four weights of bethanized coating give full protection against corrosion

To enable utilities to meet every conceivable field condition with full protection from atmospheric corrosion, Bethlehem produces strand with four weights of bethanized coating—A, B, C, and D. Each coating is 99.9 per cent pure zinc, applied to the individual strand wires by our unique electrolytic process. The coatings are ductile, and uniform in thickness.

If you have any question about which coating might be used to best advantage in a given location, call in a Bethlehem representative. He'll be pleased to look into the problem promptly, and offer recommendations.

Furnished in Common, Siemens-Martin, High Strength, and Extra High Strength			*Not furnished in Extra High Strength*
A*	B	C	D
Lightest, entirely dependable in good atmospheric conditions	Twice the weight of "A"	Three times the weight of "A"	Four times the weight of "A," for maximum protection in unusually corrosive atmospheres

**Same weight as Extra Galvanized and Double Galvanized Coatings*

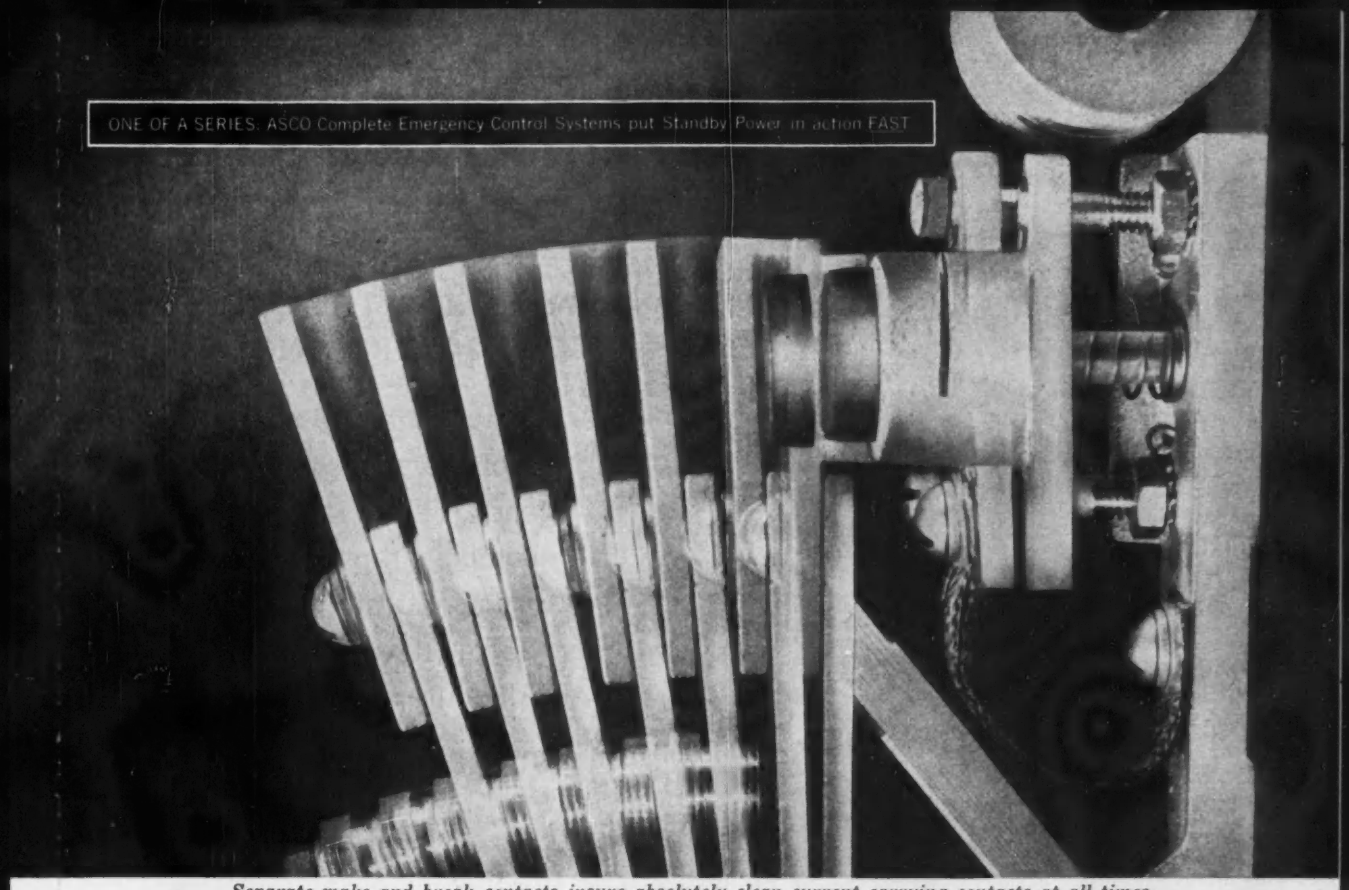
Steel *for Strength ... Economy .... Versatility*

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

ONE OF A SERIES: ASCO Complete Emergency Control Systems put Standby Power in action FAST



Separate make and break contacts insure absolutely clean current carrying contacts at all times.

ASCO Automatic Transfer Switches transfer load in 1/30 to 1/6 of a second

When a sustained outage is detected, a contact on the ASCO Automatic Transfer Switch closes in 1/50th of a second. When standby power source attains proper voltage and frequency, the switch transfers the load to the electric plant. *Time of transfer—1/30th to 1/6th of a second—up to 30 times faster than competitive switches!* This speed reflects the extra engineering quality built into every ASCO Transfer Switch. For example, rotating weight design locks contacts in position. They cannot be pulled, jarred, or shocked loose . . . perfect electrical contact and minimum power losses are assured. Powerful mechanical linkages with single coil design provide simple, sure, two-position operation. Unique interlocking makes it impossible for both normal and emergency contacts to be opened or closed at the same time . . . gives you added assurance that power will be available when you need it.

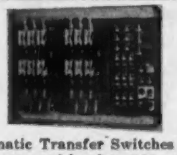
Dependable control by ASCO . . .

ASCO Electromagnetic Control

ASCO

Automatic Switch Co. 50-P Hanover Road, Florham Park, N. J. FRontier 7-4600

ASCO CONTROL SYSTEM COMPONENTS:

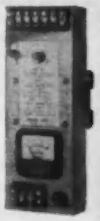


Automatic Transfer Switches *for all classes of load to 750 volts AC-DC. Transfer connected load to standby power when failure or substantial reduction occurs. Return load automatically when full power is restored — in sizes from 10 to 1200 amps. Write for Catalog 57-S1.*

Automatic Engine Starting Controls *provide fully automatic starting and stopping of diesel or gas engine driven generating sets. Write for Catalog 57-S6.*

Load Demand Controls *automatically start engine when load is applied; stop it when load is removed. Write for Catalog 57-S6.*

Solenoid Valves *for air starting applications, and for controlling the flow of cooling water, fuel oil and other liquids and gases. Write for Catalog 25.*



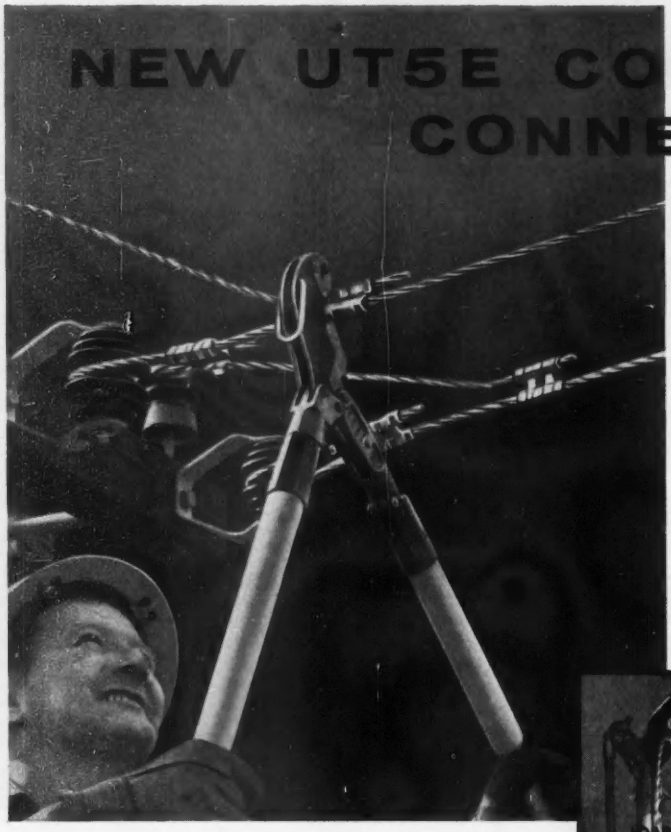
Battery Chargers *are designed for heavy duty industrial use. Provide power to keep engine generator cranking batteries fully charged. Charger can be combined with automatic transfer panel for compact, single package arrangements. Write for Catalog 57-S6.*

NEW UT5E COMPRESSION CONNECTOR TOOL

PATENTED

INSTALLS THE BIGGEST CONNECTOR RANGE EVER!

one mechanical compression tool that splices, taps, dead-ends, and terminates the complete range of conductors from #10 str. to ~~4/0 ACSR~~ 336.4 (18x1) ACSR, 350 MCM All Aluminum!



HOT LINE APPLICATION

QUICK! One stroke makes one perfect compression.

LIGHT! Complete tool weighs only six pounds!

SIMPLE! C-Shaped head with snap-in, color-coded dies is designed to simplify the job.

SAFE! Tool and connectors are designed with safety in mind.

ECONOMICAL! Priced at a small fraction of the cost of hydraulic tools. Rugged construction means long service life. Tool adjusted with a common wrench.

The following compression connectors are available for use with the UT5E tool:

Tension Splicers • Service Splicers • Loop Splicers • Single Sleeve ACSR Splicers • Angle Tap Connectors • PALTAP† Connectors • TWINTAP† Connectors • Aluminum Terminals • Aluminum Copper-Pin Terminals • Aluminum-Copper Pad Terminals • Adjustable Dead Ends

The UT5E tool is available in the following combinations:

CATALOG NO.	DESCRIPTION
UT5E	Basic tool with metal handles
UT5W	Basic tool with wood handles
UT5H4	Basic tool with 4 ft. hot stick handles
UT5H6	Basic tool with 6 ft. hot stick handles

Patents and Patents Pending on the above items

†Trade Mark

T&B ENGINEERED

The Thomas & Betts Co., Inc. 14 Butler St. Elizabeth, N. J.

PLEASE SEND ME:

- ☐ The New T&B Bulletin D59 for *Distribution*: Connectors, UT5E Tools, and Accessories.
- ☐ T&B Bulletin 70 for *Transmission*: Connectors, Tools, and Accessories.
- ☐ Information for converting UT5 Tools to UT5E tools.

Name _____

Title _____

Company _____

Address _____

City _____ Zone _____ State _____

All T&B products sold only through authorized T&B Distributors

THE THOMAS & BETTS CO.

INCORPORATED

ELIZABETH, N.J.

Thomas & Betts Ltd., Montreal, P.Q., Canada

COMPRESSION CONNECTOR MANUFACTURERS SINCE 1940

Pre-Engineering by **KAISER ENGINEERS** answers basic plant expansion questions...

Profitability? Faced with the decision to expand your plant facilities, you should first determine whether all elements combine to form a pattern of future profitability. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. The studies and evaluations furnished by KE Pre-Engineering represent only one phase of total KE services. Kaiser Engineers designs and builds all types of power plants—steam-electric, gas turbine, combined cycle, nuclear and hydro-electric. From Pre-Engineering through design and construction, Kaiser Engineers provides complete one-company service and ingenuity based on years of experience.

KAISER ENGINEERS

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Contracting since 1914

Oakland 12, Calif. — Chicago, New York, Pittsburgh, Washington, D.C.
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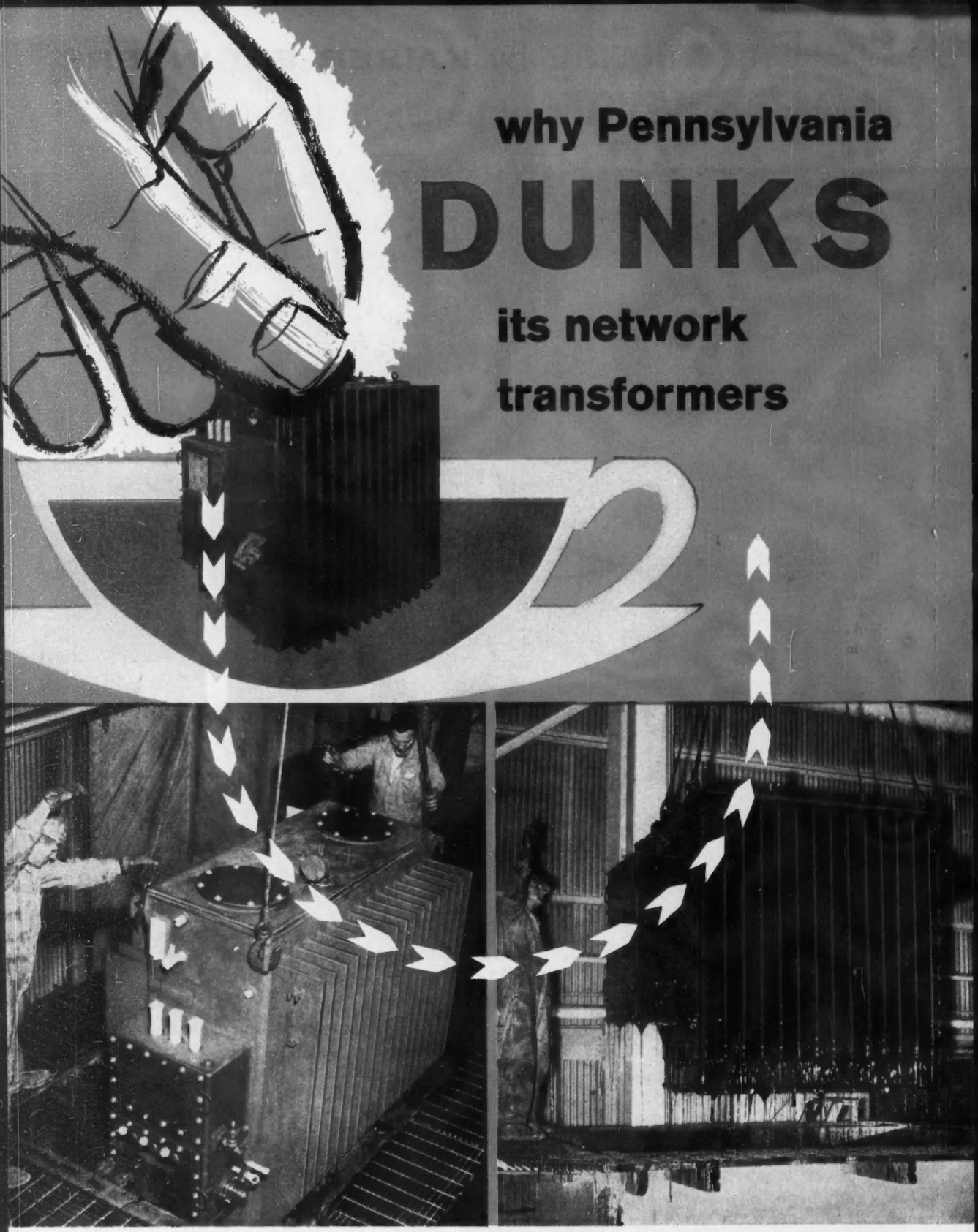
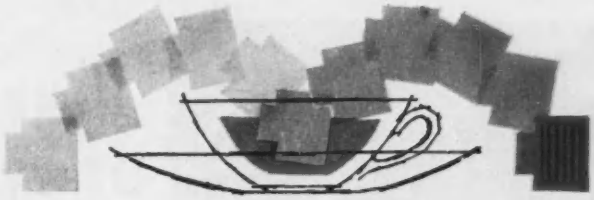
6229-P

why Pennsylvania DUNKS its network transformers



1500-kva network transformer, with auxiliary devices masked, being lowered into paint tank.

750-kva network transformer being raised to drain after coating by complete immersion in special network transformer paint.



Pennsylvania Network Transformers are painted by dunking—rather than by flow, spray or brush—because the immersion process provides 100% coverage, to the last bolt head. This guarantees *full effectiveness* from Pennsylvania's specially developed, service-proved, network-transformer paint.

Dip painting gives extra protection

Dunking covers the tank with a specified minimum thickness of paint and leaves a bonus thickness on *horizontal, lower side* and *bottom* surfaces, where corrosive conditions are most severe. Desirable extra paint collects on these surfaces as excess paint runs off after each immersion. A drying period follows each dip and the total paint thickness accumulates to as much as three times the amount on the ordinary transformer.

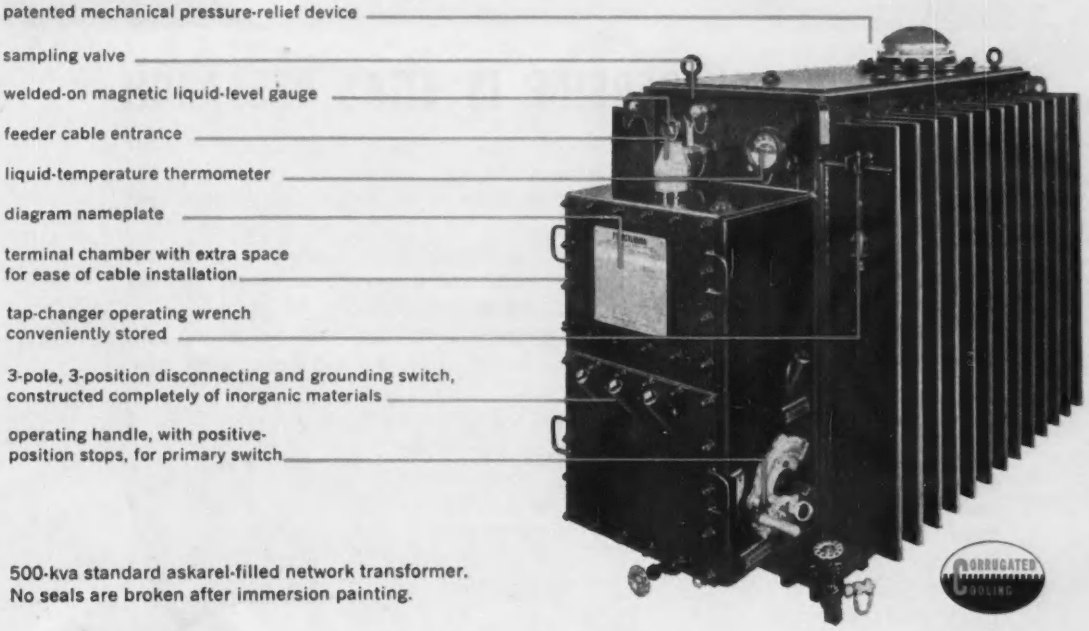
Paint system service-tested

Pennsylvania's scientifically formulated alkyd-base black subway paint provides protection against corrosion because of its exceptional ability to resist attack by oil, salt and moisture. It resists the growth of fungus; yet, it has long life in sunlight during outdoor storage. These qualities were proved by scores of laboratory and field in-service tests made in cooperation with a large eastern utility. The records can be inspected.

Maintenance easily performed

Regardless of the quality of a protective finish, periodic maintenance is necessary. And this too must be a quality job. Pennsylvania's original "Corrugated-Cooling" tank design leaves all surfaces smooth, exposed and *completely* accessible for cleaning and easy maintenance—and without special tools.

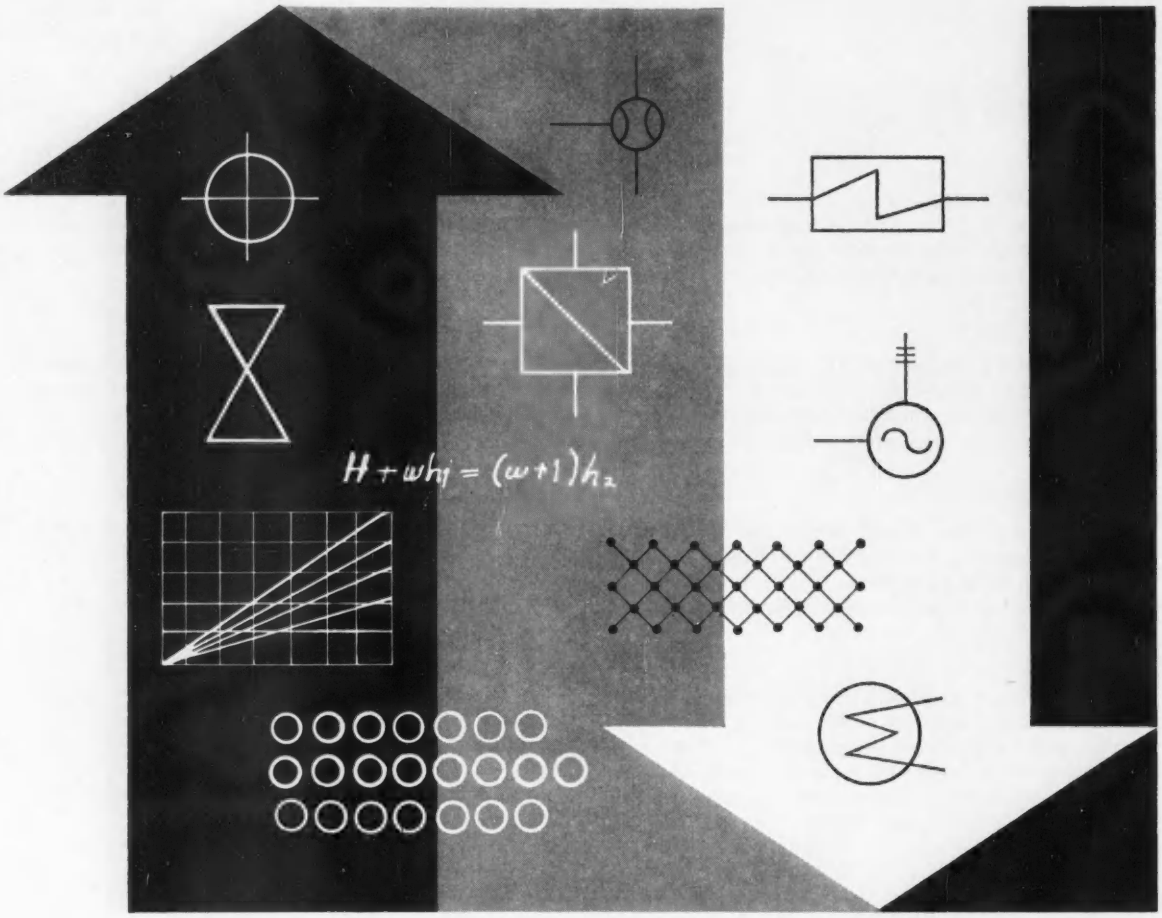
For further information on the "whys" of Pennsylvania subway and network transformer design, construction and accessories, write on your company letterhead to Power Sales Department, Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pennsylvania.


patented mechanical pressure-relief device
sampling valve
welded-on magnetic liquid-level gauge
feeder cable entrance
liquid-temperature thermometer
diagram nameplate
terminal chamber with extra space for ease of cable installation
tap-changer operating wrench conveniently stored
3-pole, 3-position disconnecting and grounding switch, constructed completely of inorganic materials
operating handle, with positive-position stops, for primary switch
CORRUGATED COOLING

500-kva standard askarel-filled network transformer. No seals are broken after immersion painting.

McGRAW EDISON

PENNSYLVANIA NETWORK TRANSFORMERS



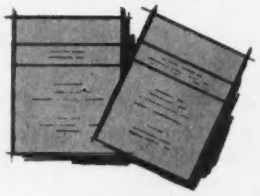
CONTINUING LEADERSHIP IN VITAL RESEARCH

What happens during the start-up and shut-down operations of power plant condensers? Do you know what sources of oxygen contamination exist in the cycle? How can the oxygen in a proposed installation be eliminated without special and costly equipment?

These are but a few of the questions answered in the free 16-page report entitled "Trends in the Design of Deaerating Condensers" published by the Research and Development Division of C. H. Wheeler.

C. H. Wheeler research has led to the ultimate in the design of deaerating condensers and we are constantly looking for better materials and designs for auxiliary power plant equipment.

For example, extensive testing is now being done on journal and bearing materials to improve performance and life of condenser circulating water pumps. Results of tests conducted to date are reported in the booklet "Performance Tests of Water Lubricated Bearing Materials for Circulating Water Pumps."



Write today for your free copy of both of these up to the minute reports.

C. H. WHEELER MANUFACTURING CO.

19th and Lehigh Avenue, Philadelphia 32, Pa.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

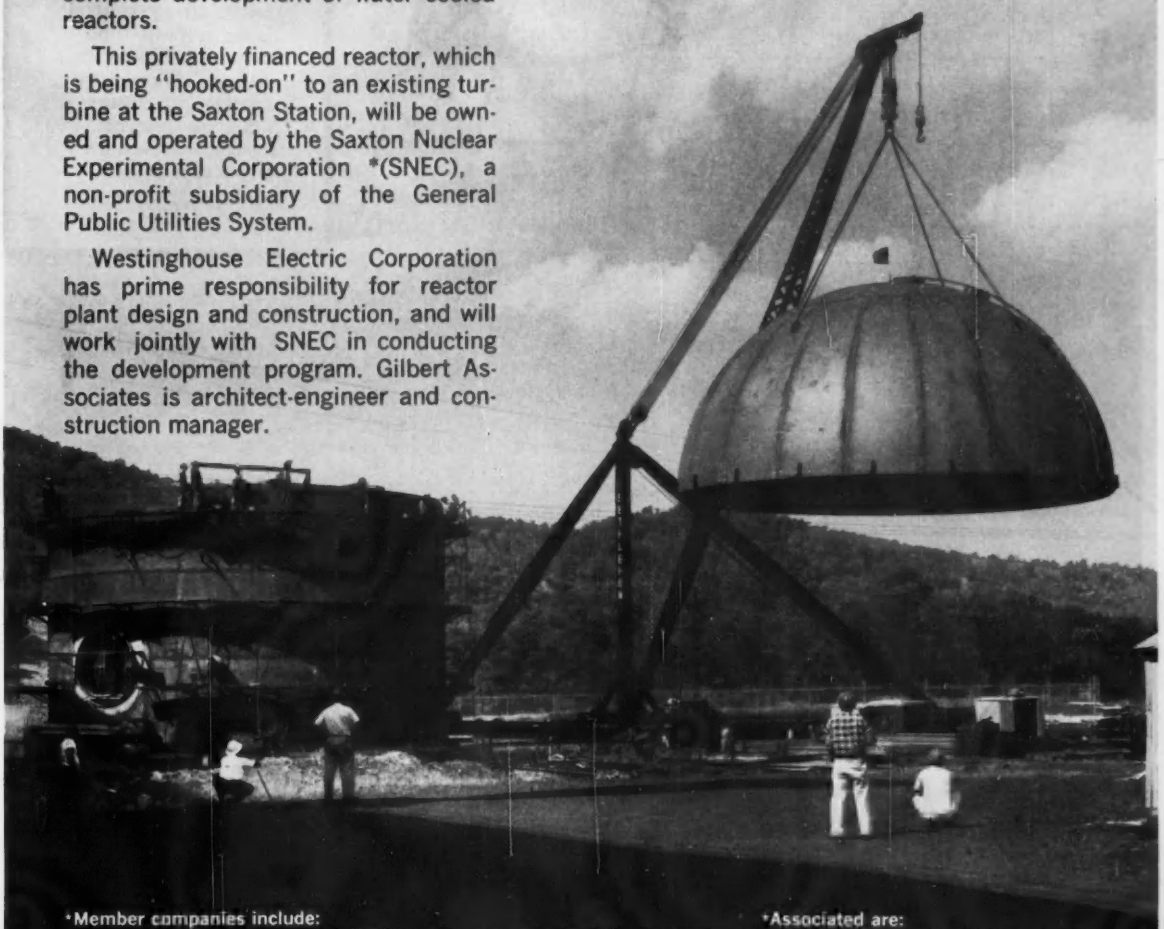
GOING UP TO BRING COSTS DOWN

Another step in the march toward economic nuclear power is made in the mountains of Western Pennsylvania as the containment vessel for the Saxton Experimental Reactor is completed.

The Saxton plant will provide a flexible nuclear facility toward the more complete development of water cooled reactors.

This privately financed reactor, which is being "hooked-on" to an existing turbine at the Saxton Station, will be owned and operated by the Saxton Nuclear Experimental Corporation *(SNEC), a non-profit subsidiary of the General Public Utilities System.

Westinghouse Electric Corporation has prime responsibility for reactor plant design and construction, and will work jointly with SNEC in conducting the development program. Gilbert Associates is architect-engineer and construction manager.



*Member companies include:
Pennsylvania Electric Company
Metropolitan Edison Company
New Jersey Power & Light Company
Jersey Central Power & Light Company

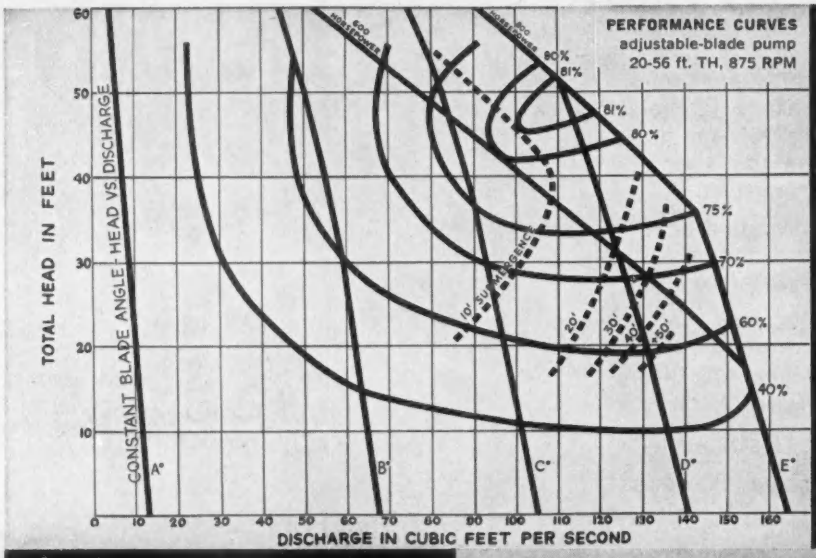
*Associated are:
The Pennsylvania State University
Rutgers University

A SYMBOL OF GAI FOUNDED 1906 PROGRESS

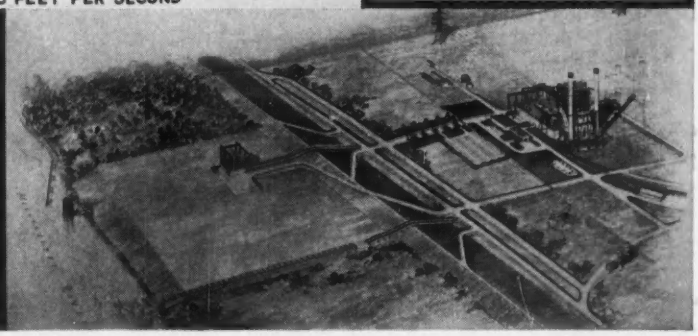
GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSTRUCTORS
READING, PENNSYLVANIA

ALLIS-CHALMERS

A-1393



Performance curves of the A-C adjustable-blade axial flow pumps for Willow Glen illustrate their extreme flexibility. Pump operation is not restricted to a single head-discharge curve as is the case with fixed-blade pumps, but provides any discharge and head combination within the limits of motor horsepower and proper submergence.

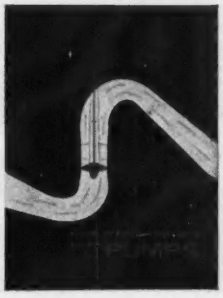


Stone & Webster Engineering Corp. is designing and constructing the Willow Glen Plant at St. Gabriel, La. on the Mississippi River for Gulf States Utilities Co.

Flexibility and efficiency make Allis-Chalmers adjustable-blade pumps choice for Willow Glen

Two 30-inch Allis-Chalmers adjustable-blade axial flow pumps provide condenser water for Unit #1 at the new Willow Glen Power Station. To meet requirements at minimum river level, with water temperatures that vary between 39°F and 90°F, the pumps were designed to deliver a total of 76,000 gpm against a 54-foot total head.

Extreme variation of suction pool elevation and the flexible condenser operation required for this station made adjustable-blade pumps the logical and economical choice. A-C adjustable-blade pumps attain relatively high efficiencies over a wide discharge and head range. This is accomplished by varying the pitch of the impeller blades while the pump is operating at constant speed. This adjustability keeps pumping costs at a minimum by combining low starting torque with high average efficiency.



Pump Bulletin 165 will give you complete information on high capacity axial flow pumps. To get your copy, write to **Allis-Chalmers,** *Hydraulic Division, York, Pennsylvania.*

Electrical World

NOVEMBER 21, 1960

Editorial Comment

This 'Little' Agency Went to Market

Tennessee Valley Authority has marketed its first publicly offered bonds. The issue received a calm acceptance.

This must be taken as clear, final evidence that even a sophisticated public has little interest in the merits of the conflict between investor-owned utilities and federal power.

TVA management was able to present an excellent case to the underwriters. In response, Moody's Investors Service and Standard & Poor's Corp awarded their highest bond ratings. This is not surprising. Consider the subordination of principal and interest payments owed to the US Treasury, to those of the new bonds. Consider the new bonds' security: excellent revenue plus depreciation charges on utility plant. Consider the law-granted privilege of banks to handle the new issue, not extended to other corporate securities.

Did the investment fraternity question the equity of regional federal power to *all* citizens of the land? Did it concern itself with the propriety of TVA's being reared as a favored government ward, now thrust into the business world with pockets jingling with taxpayer-supplied assets? Did it note the insidious orientation toward steam power and away from TVA's original valley resources intent? Did it reflect that it is dead against government-in-business in other spheres?

No. With the chips down, the investment fraternity overlooked these matters. It viewed TVA simply for its investment attractiveness.

It is said that the public, properly educated in the basics of the free enterprise system, will turn from federal power. We submit that the investment fraternity qualifies as well educated.

This is but another event demanding a return to realism in the approach to federal power.

Continue to educate the public, yes. This must always be a high objective, one which can lay the long-term framework against leftward shifts in public attitude.

But the main emphasis must go elsewhere. The investor-owned utilities, working together to integrate their systems, must do such a tremendous and complete job in supplying electric energy that in *no other region* can anything like TVA get a foothold.

AEP Safety Takes a Hint From the Birds

Birds and squirrels have perched and traveled on high-voltage lines with impunity ever since such lines were established. But only recently have men dared those electrified precincts without preparatory rubbering up. Now the American Electric Power System sends up its linemen as unencumbered as sparrows.

AEP didn't have to be knocked into a line of reasoning as Newton was by a thumping apple: The principle of the birds' impunity was understood from the beginning. But following their example entailed a long process of research and development to find the means for exploiting today's new materials. As usual such an undertaking was accepted by AEP gladly and energetically. The result, as announced in *Electrical World* (Nov. 7, p 80), was achieved with a new insulated aerial boom, supporting a fiberglass bucket lined with metal mesh.

As the metal mesh is clamped to the hot line being serviced, the linemen are charged at the conductor's potential, just as the birds are when perching. And like the birds, they are physically unaware of this high potential, as there is no flow.

The full impact of this new technique won't be felt for some time, but we predict it will be substantial.

WPPSS and PNP attorneys clash in getting . . .

Snake River Hearings Underway

Evelyn Cooper promises that WPPSS will take 'every step necessary' to see that Nez Perce—not High Mountain Sheep—is the dam that is constructed

The Nez Perce—High Mountain Sheep battle finally has been joined at the Federal Power Commission, as heated words marked the opening of hearings on cross-examination.

Legal maneuverings and side issues continued to be a major source of activity, as they were during the week prior to the opening of the hearing (EW, Nov. 7, p 78).

FPC Examiner William C. Levy started the hearing, and is keeping it going full-steam-ahead, after ruling against three motions to delay, each filed by Mrs Evelyn Cooper, attorney for Washington Public Power Supply System. The motions were: **(1)** A delay of hearings to Jan. 9, **(2)** A motion to reconsider his denial of the delay, **(3)** A week's delay so WPPSS could file a similar motion with the full Commission.

Mrs Cooper, however, has filed motions with the full Commission to delay or impede the proceedings: **(1)** She requested the same two-month delay that Levy had turned down, **(2)** She sought to reverse Levy's earlier denial of her motion to subpoena two FPC power staff members, Francis L. Adams and Lesher S. Wing, on grounds they may have influenced FPC staff engineering witnesses in favor of High Mountain Sheep (EW, Oct. 31, p 49).

She also asked Examiner Levy to subpoena records of Pacific Northwest Power Co on grounds that PNP—applicant for High Mountain Sheep Dam—may not be a qualified licensee under antitrust rules of the Federal Power Act.

The new WPPSS motion against PNP's antitrust status is similar to a charge made several years ago against PNP, when it had filed for the two low dams at Mountain Sheep and Pleasant Valley sites on the Snake River. That motion was turned down. The antitrust charges are based on Section 10 (H) of the Federal Power Act, which prohibits any "combinations—to restrain trade," and on Section 305 (B) of the Federal Power Act, against interlocking directorates. This obviously is aimed at the joint control of PNP by Portland General Electric Co, Washington Water Power Co, Pacific Power & Light Co and Montana Power Co.

Questions Nez Perce Merits

PNP Attorney Hugh Smith blasted WPPSS in his opening remarks with the charge that he doubts whether the public body "has any stomach" to bring Nez Perce to trial on its merits. He charged that WPPSS would turn the FPC hearing into a political issue because it couldn't hope to win its case in competition with High Mountain Sheep.

"If they were acting in good faith," Smith said, why didn't WPPSS file for Lower Canyon Dam? This wouldn't conflict with High Mountain Sheep, and it could be built as soon as Nez Perce—when the fish problem is solved.

Smith said that PNP had turned down an "open FPC bid" to file itself for Nez Perce project after the Commission had rejected the company's earlier application for low Mountain Sheep—Pleasant Valley Dams. He said PNP's decision to file instead on High Mountain Sheep and Lower Canyon was based partly on the "erroneous testimony on fish" in the earlier case—that Nez Perce fish facilities would work as well as those then being developed for Idaho Power Co's Brownlee Dam. Smith pointed out that Brownlee facilities subsequently "have failed," and he said there's no reason to think that ones for Nez Perce would work either.

High Mountain Sheep project would afford more resource development, more operating flexibility, lower costs than Nez Perce, Smith continued. He said PNP's figures were based on precise engineering data "to inform us on what project to file for, not to prove a case."

If WPPSS is licensed, it will be a "monster," said Smith . . . it will "ignore" law on the ground it is not subject to utility regulation.

Both Smith and Mrs Cooper claimed the proposed US-Canadian development of the Columbia River (adding up to 1.7 million kw of new prime power to the US) would have no effect on their own projects. Mrs Cooper said the plan would take pressure off FPC for a "quick decision" in favor of High Mountain Sheep. Smith said PNP looked forward to the proposed agreement with "pleasure and excitement," but that all the Columbia Power, plus that at High Mountain Sheep, would be needed in the Pacific Northwest.

FPC Staff Attorney Donald Sander said he would take no position in the case until the hearing had ended. He said he might decide: **(1)** for Nez Perce, **(2)** for High Mountain Sheep, **(3)** against both.

Intervenors Speak Up

Intervenors had their say, too. Jonel C. Hill, Oregon Public Utilities Commission chairman, pointed to the "unified" position of his state in favor of High Mountain Sheep—an apparent jibe at Washington where the fish agency is testifying for High Mountain Sheep while the Washington Department of Conservation is testifying for Nez Perce. Hill said his state would be "compelled to require a determination" in court as to whether WPPSS could build a dam in Oregon without first acquiring an Oregon license.

Kennedy Starts Agency Study

Within two days after his election as president, John F. Kennedy appoints James M. Landis to study regulatory agencies for reforms

By Dec. 15—more than a month before he moves into the White House—President-Designate John F. Kennedy will have preliminary recommendations for streamlining of the operations of government regulatory agencies. The recommendations, which could have an important bearing on the future functioning of the Federal Power Commission and Securities & Exchange Commission, will get priority attention from the new chief executive.

Immediately after the election, Kennedy announced that James M. Landis, an old friend and trusted adviser, would recommend to him ways to speed up regulatory agency decisions and to find the best men to sit in judgment on the regulated industries.

Landis was given only about 30 days to do the job, but he already had a head start on the assignment. As a protege of Harvard Professor Felix Frankfurter, now a Supreme Court Justice, Landis moved into Washington in the early days of the New Deal to help draft legislation which eventually led to creation of the SEC. He later was named to membership in the securities agency and moved up to its chairmanship when Financier Joseph P. Kennedy, the president-designate's father, resigned.

Has Broad Agency Experience

Landis subsequently served as a member of the Federal Trade Commission and, during the Truman Administration, as chairman of the Civil Aeronautics Board. As dean of the Harvard Law School, he maintained a continuing interest in the affairs of the regulatory agencies.

From his own experience on regulatory agencies themselves and in his practice since he left government service, Landis is among the more well informed men in Washington—and feels no need for making any special "survey."

Landis will begin work in earnest on the project for Kennedy this week. A special office has been set up for him in Washington, separate from the law office he maintains there.

In preparing his report, he will meet with a number of government department heads and with the chiefs of the regulatory agencies. Authority for these conferences was granted as part of the government "takeover" agreement worked out last week by representatives of President Eisenhower and Kennedy.

Landis' recommendations will be made in stages over a period of months. His first report will be a preliminary one and deal only with what he considers the most urgent matters that Kennedy should act upon in the opening days of his administration.

What recommendations will Landis make to the new administration? He is keepinng mum on specifics, but there are a number of clues as to his thinking.

Favors Regulatory System

For one thing, he has made it clear that he is no foe of the regulatory system and does not agree with a few experts who recommend that some or all of the agencies be abolished. Nor does he plan to call for sweeping reorganizations. Instead, he will recommend a number of steps for improving the agencies' efficiency and to reverse what he considers a downward drift in the caliber of men who serve on them.

In a speech to the American Bar Assn last August, Landis tipped his hand as to what he thinks should be done. He particularly emphasized his belief that agency appointments should not be used as stepping stones by political figures who are really interested in other jobs.

Landis said more attention should be paid to the backgrounds and experience of men who are named as government regulators to make sure they are really qualified. He would like to see minimum standards established, much like those which are applied to judgeship appointments. He also said:

- That rules of evidence and procedure should be strengthened to make sure agency hearings don't drag on unnecessarily and that the record does not become so voluminous that it is seldom read in full;
- That hearing examiners should be given greater authority to halt delaying tactics and to keep proceedings moving swiftly;
- That the large number of appeals of hearing examiner's decisions to top members of the agencies should be cut sharply by setting up an appellate procedure similar to that used in the courts;
- That agency members should halt the practice of handing out to anonymous staff personnel the job of writing their opinions;
- That agency members should devote more time to creative policy thinking—something they can accomplish only if they are relieved of the burden of adjudicating so many minor controversies.

LANDIS

With Landis in the picture, it is not clear what will happen to an Eisenhower Administration project just getting under way in the same field. Eisenhower, acting at the behest of the present heads of the regulatory agencies, has named US Appeals Court Judge E. Barrett Prettyman to organize a new administrative procedures conference that would seek ways to speed up regulatory agency decisions.

Plant Automation Moves Ahead in US

Computer control is announced for first European plant, first US peaking plant, and first US coal-fired plant

Three recent contract announcements highlight the growing use of control computers in the electric power industry. Previously, computers had pushed the buttons only in the United States, and even here they were limited to base load plants that were either oil or gas fired. But these restrictions have broken down. The computer trend has dented the European industry with Electricité de France's announcement of a computer controlled plant at St. Ouen. In addition, Gulf States Utilities will put an electronic brain in charge of control functions at its Riverside peaking plant, and Carolina Power & Light will convert its coal-fired Goldsboro station to automatic control.

France Installs Europe's First

The European first is a 250-Mw plant which is twice the size of groups EDF has put on the line in the past. It uses a $460,000 Thompson-Ramo-Wooldridge computer which will continuously calculate specific fuel consumption and will indirectly control the station's generation. This is a major step in Europe toward complete computer control of power production. The St. Ouen location will begin operation in October, 1962.

The data processing system will monitor and record some 600 process variables ranging from such critical parameters as steam pressures and temperatures down to less important bearing temperatures. From these inputs, the computers will calculate actual specific consumption along with the best possible consumption rate for the load conditions. Differences between the two at eight key points in the steam generating equipment show up on a control console which indicates immediately to the operator what adjustments he should make.

EDF's approach to automatic control is two-sided. In plants like St. Ouen where design steam conditions at the turbines are 2,350 psi at 1,050F, and peak flow tops 1,600,000 lbs of steam an hour, control instrumentation becomes so complex that human operators just can't react quickly enough. This makes automatic control of startup and regulation sequences a must. In addition, EDF thinks that automatic control can cut down specific consumption as well as operator error, and make the computer a money saving investment. Even though the planned processing system which flashes its suggestions to men, is only a stepping stone to complete computer control, it gives some indication of the economies in the future. The semi-automated system will cut consumption by 6 calories per kwhr. Complete automation would do even better.

The control systems which will go into the plant are purposely overdesigned. Manual controls at St. Ouen will operate side by side with automatic regulating devices. This allows engineers to evaluate full computer control in actual operation. EDF feels that the extra cost is well spent for the experience it provides. Whether or not EDF eventually moves to complete computer control with the data processing system tied directly to the automatic control equipment will depend on this operating experience.

A big factor in favor of complete control is already in sight. The systems for subsequent groups can be brought in at lower cost than the first one. The two computers in the first group operate in parallel to get, for all practical purposes, 100% reliability. For each additional group, EDF hopes only one computer will be needed. The standby computer of the first group could backstop the single computer of each additional group. In the meantime, EDF plans to use the standby computer for scientific calculations such as stability of control elements using the process variables that are continuously fed to both computers.

Gulf States Utilities Co will be the first power company to apply computer control to a peaking plant. With the installation of its "Systemation" project at the Riverside power station, it will also become the first utility to automate a station already in operation.

The heart of this conversion at Riverside is a high-speed digital computer which will be designed and manufactured by Consolidated Systems Corp in which Allis-Chalmers holds a half interest. When it is fully operational, the computer will control the two-unit 75-Mw plant with increased safety to men and equipment. Allis-Chalmers is also the prime contractor for the conversion. According to a Gulf States' spokesman, "It is merely a matter of backfeeding the circuit and the automatic station is within our immediate reach." Turbine modifications will include the addition of a wide range governor to control the turbine speed setting from turning gear speed to operating speed, and a means of sending values for thermal expansion and bearing vibration to the computer.

Start-up Time Will be Reduced

Besides precision of operation, Gulf States expects that Systemation will reduce the plant's start-up time. At present, it takes Riverside eight to ten hours to put a cold boiler on the line and begin producing power. The computer will cut this time by 25% or more, depending on the thermal expansion characteristics of the turbine and boiler. Response time in case of normal load drop and emergency load drop should also be chopped by about 25%.

In controlling the Gulf States' plant, the data processing system will monitor as many as 500 parameters. These include the flame, water level, temperatures, pressures, and flow variations. The computer records trends for any ten or twelve conditions that may be of concern to the operator and takes corrective action to bring these indicators to ideal levels. In this way, the Systemation project, which will be completed in late 1962, allows the turbines to be started automatically for peak loads and to be shut down when the load decreases.

The first automated coal-fired steam station was announced recently as Carolina Power & Light

and Europe

Co awarded a contract for automating its new 265-Mva Goldsboro (N.C.) No. 3 unit to Daystrom, Inc. Control of the boiler-turbine centers around a "steam power automation and results computer (SPARC)," which includes analoy sub-loop control and provision for evaluating the reasonableness of the input data.

The SPARC system will feed up to 900 digital inputs, and 600 analog inputs into the computers. Under automatic control the computer will control among other things, the 800 to 1,000 steps involved in the start-up process.

Fuel for the 1,260,000 lb-per-hr boiler is supplied by a bank of five coal pulverizers whose operation will be under control of the computer. Steam is supplied to the 265-Mva turbine generator at 2,500 psi and 1,000 F, with reheat to 1,000 F.

TWO-TURBINE UNIT at Gulf States' Riverside station will take its orders from a computer. It will be the world's first computer-controlled peaking plant

Information Reliability Is High

Guaranteed reliability of the information of 99.9% is called for as well as 99% availability of the computer over an agreed upon six-month period.

Approximately 2,500 points throughout the plant will be monitored and many of them will be compared to operating limits for maximum safety on plant operations.

The start-up and shut-down procedures will be carried on a lower speed, magnetic drum for immediate use when required.

The analog, sub-loop control system will provide regulation in four ways: **1.** Conventional remote manual, **2.** Conventional sub-loop automatic, **3.** Computer supervised manual, **4.** Computer supervised sub-loop automatic.

This system will control such things as combustion, re-heating steam temperature, super-heating steam temperature, feed water, fuel cut back, or heater temperature and pump by-pass.

The analog system will also be non-interacting, bumpless when transferring from one mode of operations to another, and will be backed up by the digital sections in the event of a failure.

The flexibility of this control system is provided by utilizing an unusual tri-dimensional modular design. An arithmetic and control section provides major program direction and decision making.

The system can operate either in supervisory control mode and select the correct routine while maintaining minimum net heat rate, or it will monitor the status of plant equipment while station operators use manual control.

It will collect operating data, convert input signals to digital form, perform the required arithmetic operations and compare collected data with fixed or calculated limits to determine whether variables are within required operating range.

It also evaluates the reasonableness of input data and rejects obvious open circuits or erroneous data. Pre-set limits will be stored in a high speed, magnetic code memory and can easily be changed by the operators when required.

Supreme Court Will Review Fermi Case

The US Supreme Court has just decided to review the Enrico Fermi fast breeder case. The Court's decision, thus, was to grant requests of the Atomic Energy Commission and the Power Reactor Development Co for further review of the District of Columbia Court of Appeals decision setting aside the construction permit AEC originally issued for the power reactor project. Three AFL-CIO unions objected that the fast breeder represented a reactor technology unsafe to locate near heavily populated areas.

In electing to hear the case, the Supreme Court has restricted the scope of the entire proceeding to consideration of the following two questions: **1.** Can AEC issue a provisional construction permit without reasonable assurance there will be no danger to public health and safety; **2.** Can AEC authorize construction of a reactor near a population center without "compelling reasons" for locating in such a place.

Though oral arguments could be heard in December, with the Court's heavy backlog of additional cases to be scheduled for review, the Fermi matter will probably come up after the first of the year.

Rate Reduction Offered

Hearings began Nov. 9 in Miami on a system wide investigation of Florida Power & Light Co rates.

As a step toward arriving at a quick agreement, McGregor Smith, chairman of the FP&L board, offered to put in a uniform rate over the company's system in place of the present two zone rates. This would reduce FP&L's earnings by $1,300,000.

The Commission has made no decision as to whether it will follow Smith's suggestion that the two staffs confer.

EEI Surveys Nation's Power

Institute's 28th electric power survey traces utilities' growth, predicts capability and peak loads into 1963

Annual growth rate for peak loads and peak capability will fall during the next three years. Despite predicted deceleration, annual increase for the five-year period 1958-1963 will still be a healthy 7.3% in peak capability, and 7.6% in peak load.

Edison Electric Institute's semi-annual power survey predicts the rate of increase in 1963 will be 6% for capability and 6.9% for peak loads. In 1959 the comparable figures were 9.9% and 7.3%.

Growth Is Highlighted

The growth of electric power in the US during the past 15 years comes through clearly in the survey. As the chart below shows, capability three years from now will be at 211,100,000 kw which represents an annual increase of 9.1% during the 15-year period beginning in 1948. December peak load should reach 168,900,000 kw boosting it at a rate of 8% a year over the 15-year period. Electric power consumption has increased steadily through most of the country, and at a rate far higher than even optimistic estimates attribute to the American economy in general.

Other trends show up in EEI's survey. One is toward lower gross margins between peak loads and capabilities. 1959 had December margin at 30.2% of peak load. By 1963 the figure should be down to 25%. 1959's summer margin of 27.2% will drop to 22.3% in the same period. This is favorable, since it indicates that utilities will be making greater use of their equipment, and getting more return on fixed investment.

The gross margin is inadequate in only one area of the country. In the West Division of Region 7, gross margin becomes a negative figure under adverse hydro conditions. Pacific Northwest utilities, therefore, draw up power supply contracts which allow them to interrupt service whenever necessary to conserve water.

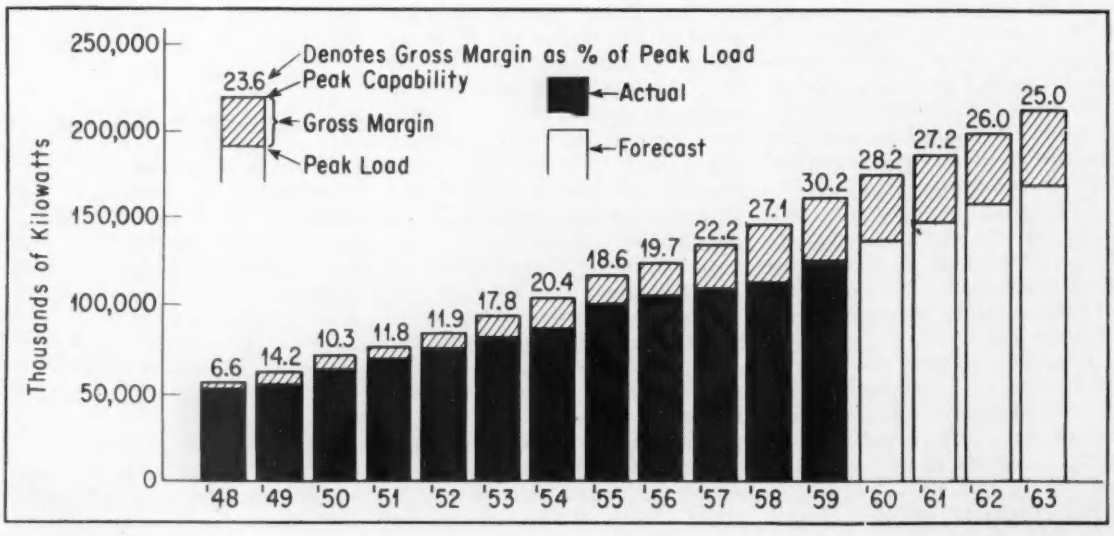
Another clear trend is the relative increase in summer peaks. Southern regions, which use extensive power for air conditioning, estimate that by 1963 summer peaks will be as much as 38% greater than December peaks. But in the North December is still high, leaving the national average for summer and winter just about even.

American load factors will remain almost unchanged, the survey predicts. In 1960, the factor is 64.4. By 1963 it will ease up very slightly to 64.7.

EEI points out that the development of atomic power moves ahead steadily, paced by research achievements and engineering and economic considerations. Six systems now use atomic power in their electric generation facilities. These reactors account for about 393,500 kw. Sixteen atomic power plants are now under construction throughout the nation. When they go critical they will generate an additional 829,300 kw. Four more atomic installations are planned, but have not yet reached the design stage.

EEI defines capability as the maximum kilowatt capability of the systems with all power sources available and no allowance for outages. It assumes normal interconnection of facilities. The survey also covers a few industrial installations that are interconnected and operated in coordination with utility systems.

The institute derives figures for the total electric utility industry by adjusting the sum of regional totals upward to account for the omissions in the actual survey coverage.



News Scope

DOUBLE-TAKE — *Electrical World's* Bogota, Colombia, reporter, after reporting last week (EW, Nov. 14, p 22) that American & Foreign Power Co and the Colombian government might not negotiate the sale of A&FP's electric utility, received new information. Colombia might be interested in buying the utility if ten-year terms for payment can be worked out. Price is said to be $27.5 million.

OPPOSITION—Mayor of Cornwall, Ontario, is opposing an application by Ontario Hydro-Electric Power Commission for a license to export power to the United States (EW, Nov. 7, p 76). He says the license should be refused until Ontario Hydro agrees to sell power to two investor-owned companies serving the city. The two are: Cornwall Street Railway, Light & Power Co, Ltd, and St. Lawrence Power Co.

WORLD'S FAIR—An organization to plan, manage, design and construct services and facilities for exhibitors at the 1964-'65 New York World's Fair has been formed. Called V-E-K Associates Inc, the organization is comprised of Vandeburg-Linkletter Associates, Inc, Ebasco Services Inc, and Walter Kidde Constructors, Inc.

PURCHASE—Electric and water systems in Rock Springs and Green River areas of Wyoming will be purchased by Pacific Power & Light Co from Southern Wyoming Utilities Co, a subsidiary of Union Pacific Railroad. Purchase includes a 20-Mw steam generating station owned by Union Pacific Coal Co, another Union Pacific subsidiary. Price is $3.2 million.

IT'S OFFICIAL—West Penn Electric Co will now be known as Allegheny Power System Inc. Stockholders approved the change Nov. 9. New York Stock Exchange symbol will be APW.

Dateline . . . Portland, Ore. (*Continued from page 5*)

Electrical World contacted BPA to find answers to the questions, and learned that BPA's push for new industrial contracts arises from its concern over deficit operations for the past three years. Largest factor in this has been faltering sales of secondary energy, principally to aluminum and other electro-process industries, but also to investor-owned utilities. The fall-off in secondary sales has cut BPA's annual revenues about $5 million.

With secondary energy coming out its ears and finding that for the past two years it had a surplus of firm power, BPA came up with its plan to recoup some of its loss. The plan: To offer industry 150 Mw of 20-year firm power if it would also contract for an equal amount of secondary. With the available firm now all committed, BPA anticipates new annual revenue of $6.5 million. BPA's fiscal 1959 deficit was $6.6 million, will be closer to $10 million for fiscal 1960.

None of the firm power has been trimmed from investor-owned utilities. BPA offered them first crack at it, although certain they wouldn't be interested. Reason: BPA has already assured them it can meet their requirements through the next four years. They didn't want to buy it to hold for future use, particularly in view of the Bonneville Act five-year withdrawal provision applicable to investor-owned utilities.

Drop-off of loads from estimates all over the Northwest, and backing off by public agencies from earlier estimated requirements from the federal system, accounted for most of the "discovered" firm power. The largest public agencies as well as investor-owned operations are now taking or committed to take large chunks of power from public agency projects like Priest Rapids and Rocky Reach dams, for which investor-owned utility contracts helped guarantee the financing. Thus, BPA is feeling competition from its own "preference" customers.

Coming on line of generation from the 17 projects completed or started by investor-owned utilities in the BPA marketing area in the last ten years has also had a large effect on BPA sales.

Re-examination of bank retention characteristics of Hungry Horse reservoir in Montana found unsuspected storage that provided a dividend of 17 Mw of firm for use in that state under the Hungry Horse reservation for Montana. This makes up part of the 45 Mw of firm committed to the Webb & Knapp steel mill. It brought the total of new firm energy also to 167 Mw.

Webb & Knapp, Inc, was the first to sign for BPA's new category of high priority "industrial power," contracting for 75 Mw, limited to 400 Mw. Industrial power takes priority over ordinary interruptible, carries a protection against its availability being cut in two by a very large upstream storage project such as Canada's High Arrow Lakes. The protection is an option to convert half of contracted industrial to firm power when such storage makes more firm power available for industry as well as other customers.

Conclusion of an Upper Columbia treaty will make more power available eventually for all BPA customers, BPA officials say.

But whether investor-owned utilities or industries will have priority for new power available is an unanswered question. Policy on marketing the anticipated new power—not available before 1965 at the earliest—has not been determined.

Pressure Suppression Approved for

Unique containment concept recently endorsed by AEC for Humboldt Bay nuclear unit eliminates usual spherical reactor enclosure, saves PG&E $650,000, exclusive of development

C. C. WHELCHEL, Chief Mechanical Engineer, Pacific Gas & Electric Co, San Francisco, Cal.

Pressure suppression reactor containment has been approved by the Atomic Energy Commission for the water-cooled nuclear unit soon to be constructed for Pacific Gas & Electric Co at Humboldt Bay Power Plant near Eureka, Cal. The unit has a guaranteed 50 Mwe capacity but is expected to produce at least 60 Mwe.

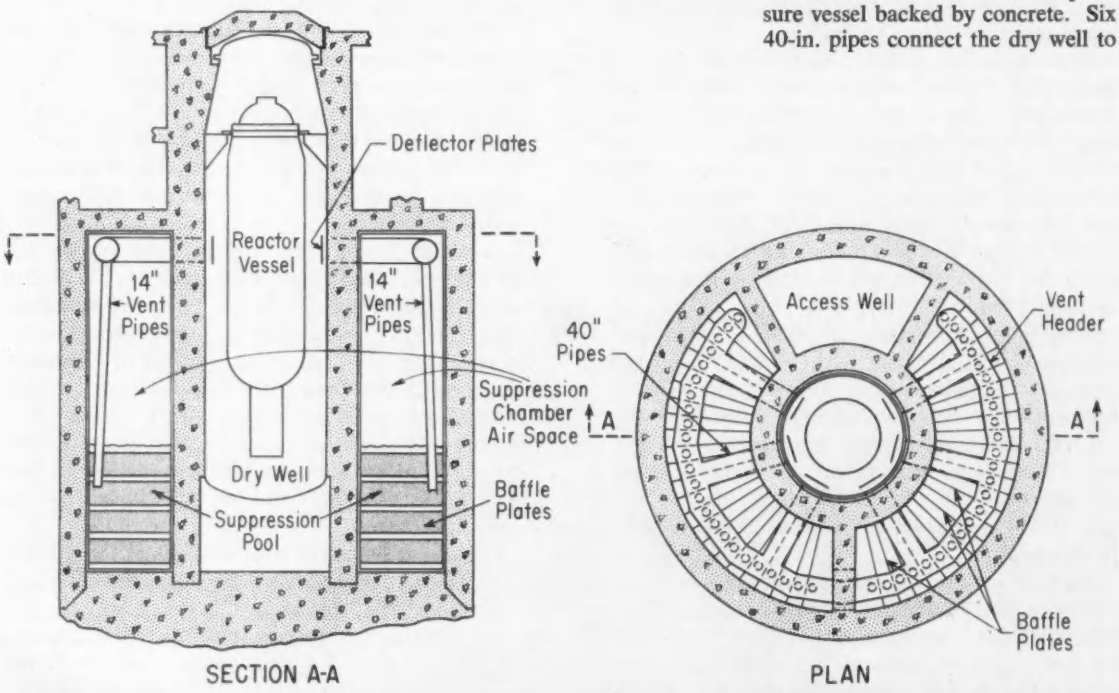
This unique design, which protects operating personnel and the public against hazards resulting from an accidental release of radioactivity, is believed to be a significant advance in the art. With this type of containment in the event of an operating accident, escaping steam from the primary system would be quenched in a water pool, thereby limiting pressure rise. This arrangement permits much simpler plant design than for other water-cooled reactors which are enclosed in large spherical or cylindrical pressure vessels.

Pressure suppression containment was selected and developed for Humboldt Bay Unit No. 3 because it offers several advantages:

- It is a simplified, less expensive design than conventional dry containment.
- Its small physical size makes it economically feasible to locate below ground, which affords added support for the structures and serves as a radiation shield in all directions except overhead.
- Energy released in event of an accident would be quickly absorbed by quenching in a water pool.
- Fission products would largely remain in the small volume of the dry well in event of a maximum credible operating accident (MCOA). This would greatly limit the spread of radioactive material, permit direct radiation shielding to be localized and highly effective, and permit subsequent plant clean-up with a minimum risk of accidental release or exposure to personnel.
- If leakage from the pressure suppression system should occur, the lower resistance path would cause most of it to flow into the closed refueling building rather than through the ground to atmosphere. This building is vented through cleanup equipment and out a high stack.
- As a result of the advantages listed above, post-accident radiation levels outside the containment system would be lower than with conventional dry containment.

Principal components of the containment system design are the dry well, the vent pipes, and the suppression chamber, shown in the illustration.

The reactor vessel is in a dry well which is a steel ASME code pressure vessel backed by concrete. Six 40-in. pipes connect the dry well to



COMPONENTS of pressure suppression system are the dry well, vent pipes and the suppression chamber. If a pipe breaks in the dry well vent pipes discharge water-steam mixture into the water pool where it is quickly condensed

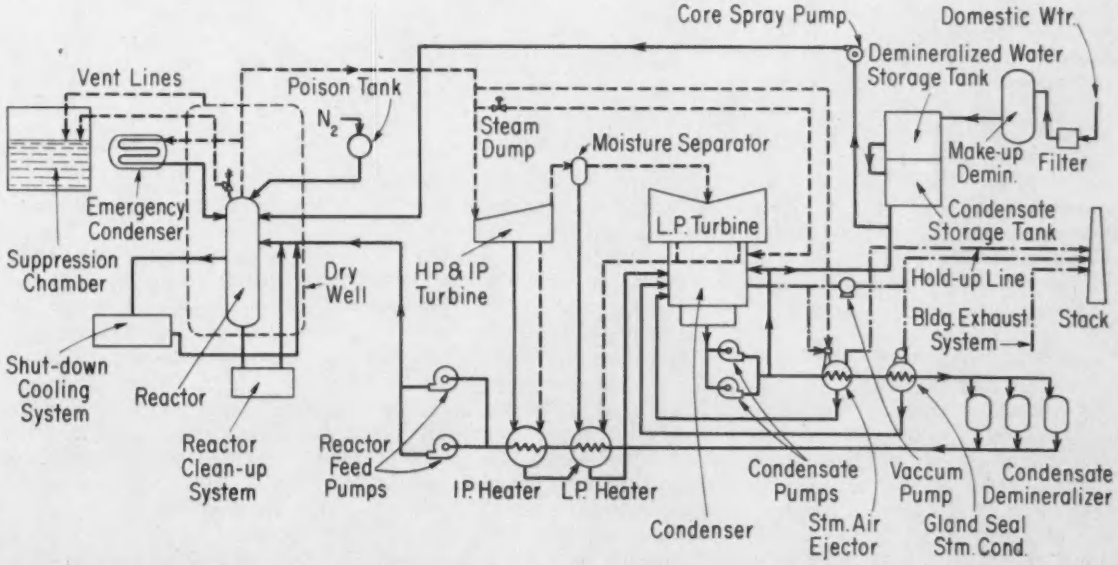
Humboldt Bay

a 40-in. equalizing vent header in the suppression chamber which nearly encircles the dry well. The 40-in. pipes are protected from possible missiles by 4½-in. thick deflector plates which also help to prevent unbalanced flow. Projecting downward from the vent header are 48 14-in. vent pipes which end six ft below the operating level of the suppression chamber water pool. Baffle plates separate the pool into 48 segments, each containing one vent pipe. Pipe penetrations into the reactor vessel are isolated by double valves welded in tandem, located outside the dry well—the body of the first valve is connected with a shroud tube which is an extension of the dry well.

In the event of a pipe break within the dry well, steam or water-steam mixture would flow through the vent pipes and into the water pool where it would be quickly and completely condensed. Whatever limited fission products from the reactor core may accompany the steam release would go with the steam to the pool, where all except noble gas fission products would be almost completely absorbed. Fission products not absorbed in the water would pass slowly through any imperfections in the suppression chamber roof (specified max leakage rate is 0.5% of volume per day) to the refueling building. Of the fission products which might be released later by fuel melting, a small fraction could leak from the dry well (specified max leakage rate is 0.05% of volume per day) into the refueling building. The flow from the building would be through cleanup equipment to the 250-ft stack.

Maximum exposure to any person on or near the site would be well within acceptable range for the max-

HUMBOLDT BAY POWER PLANT where AEC has approved installation of 50-Mwe water-cooled nuclear unit with unique pressure suppression containment. New nuclear unit will be built at the near end of existing plant above



REACTOR OF UNIT NO. 3 supplies saturated steam at 1,000 psig-546F to tandem-compound turbine exhausting to deaerating condenser. Condensate returns to feed pumps via demineralizers that remove radioactive carryover

imum credible operating accident—which is the complete severance of the largest pipe connected to the reactor vessel, followed by melting of fuel and release of fission products.

The Humboldt containment design is based upon an extensive research and development program which cost PG&E about $400,000. Exclusive of this program and related costs, the pressure suppression design is estimated to cost approximately $650,000 less than conventional containment.

The pressure suppression concept was first suggested by General Electric Co as a possible means of reducing the space and plant cost associated with large containment vessels. PG&E became interested in its potentialities and decided to finance a development program to determine its feasibility and design parameters.

Scale Model Test Made

The program included 1/10th scale model tests, full-flow condensing tests, and full-scale testing of one of the 48 segments which will make up the Humboldt containment system. The latter was conducted to check scaling factors and to demonstrate that the Humboldt design would function as predicted. The full-scale facility consisted of a 1/48th size reactor vessel, a 1/48th size dry well, one full size vent pipe, and a full size segment of the suppression chamber and pool.

Water in the reactor vessel was heated to 1,250 psig saturated, which corresponds to the design pressure of the reactor vessel. A rupture orifice was then broken, allowing the steam and water to flow through an orifice 1/48th the break size corresponding to the MCOA. This flashing steam and water mixture passed to the dry well and, by way of the vent piping, to the suppression pool.

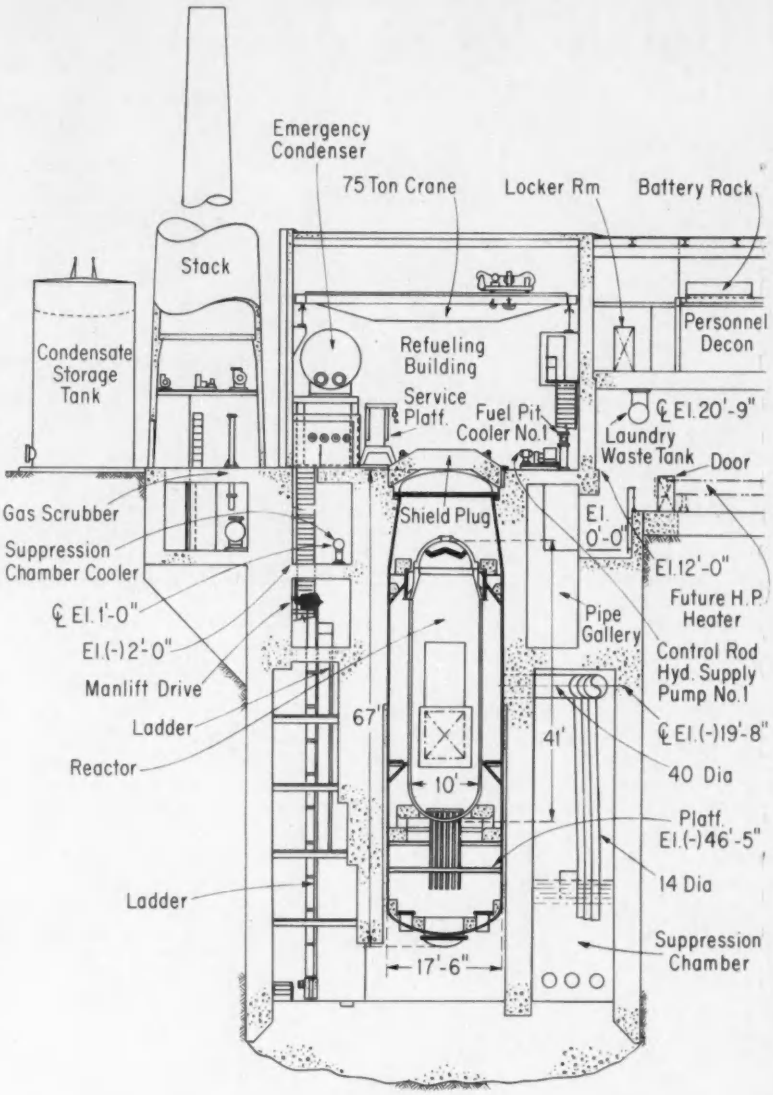
Maximum pressures during the transient were recorded for comparison with values used for design. In the suppression chamber, the highest test pressure obtained was 9.3 psig compared to the design value of 10 psig. (Due to other design considerations, the Humboldt suppression chamber is adequate for an internal pressure of 24.8 psig with normal working stresses.) For the dry well, the highest test pressure obtained for the MCOA break size was 36 psig and the design was 72 psig—the apparent lack of agreement resulted from very conservative assumptions regarding the value of orifice coefficient for a flashing water-steam mixture.

The full-scale test confirmed earlier test results and design calculations and led to acceptance by the AEC Advisory Committee on Reactor Safeguards. The series of tests yielded data valuable also to other plants for which this method of containment may be suitable.

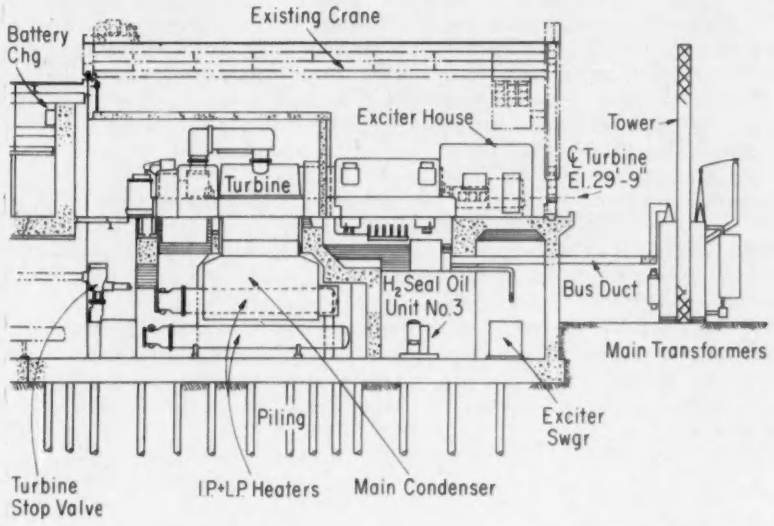
Humboldt Unit No. 3 represents an enlarged, advanced version of Vallecitos rather than a scaled down Dresden.

The Humboldt design blends the expected low fuel cost of Dresden with the low capital cost of Vallecitos. Simplification is achieved, while maintaining safety and reliability, by reducing unnecessarily high margins in design and operation as a result of favorable experience at Argonne and Vallecitos. Advances in conventional plant design and nuclear technology, which are compatible with low cost at this time, are being included.

The reactor for Unit No. 3 will be a direct-cycle boiling-water type employing natural circulation with complete internal steam separation



REACTOR AND CONTAINMENT are in cylindrical concrete caisson beneath refueling building. Vertical access shaft connects refueling building with equipment compartments and bottom of caisson where control rod drive equipment is located. Shutdown cooling system is in upper part of caisson



and drying. It will have the largest steam flow of any reactor designed for generating power using the single cycle principle. Natural circulation results in elimination of special recirculation pumps with their requirements of minimum leakage.

Subcooled Water Removes Heat

Heat generated by nuclear fission in the reactor core is removed by the slightly subcooled water which enters at the bottom of the core. The water is heated and a portion of it is vaporized as it passes up through the core. The steam-water mixture goes out the top of the core and up through the chimney section. A large portion of the driving head required for natural circulation is developed by the steam-water mixture flowing through the chimney. The steam separates from the water by gravity entirely within the reactor vessel, with the steam passing through dryers and leaving through the opening in the top of the vessel. Water that is recirculated flows down the outside of the chimney, combines with reactor feed-water of lower temperature, flows down past the shroud, and enters under the core support where it starts another cycle.

The fuel consists of slightly enriched uranium oxide pellets encased in zircaloy tubing with 36 individual fuel rods grouped into a fuel assembly. Stainless steel is being considered as an alternate cladding material. All 172 of these assemblies are supported vertically in the reactor vessel to form a cylindrical core 83-in. high with an 83-in. circumscribed dia. The 32 cruciform-shaped control rods of boron stainless steel poison sections enter from the bottom—these are 72-in. long, spaced on 10.5-in. centers. Eight additional control rods will be required if stainless steel is used for fuel element cladding.

Reactor in Concrete Caisson

The reactor and its containment structure will be centrally located in a cylindrical concrete caisson directly beneath the refueling building. The caisson is a monolithic structure extending from elevation +12 ft to −66 ft. The top flange of the reactor is 15 ft below grade, within the dry well vessel which is 67 ft high and 17½ ft in dia.

The total volume of the suppression chamber is approximately 50,000 cu ft, of which 20,000 cu ft is occupied by the water pool. A vertical access shaft on the north side of the caisson connects the refueling building with the equipment compartments and with the bottom of the caisson where the control rod drive hydraulic system equipment and caisson sump are located.

The reactor shutdown cooling system located in the upper part of the caisson provides for reduction of reactor temperature and removal of decay heat after shutdown. Design capability corresponds to the estimated decay heat rate at seven hr after shutdown. Reactor coolant temperatures will be maintained at less than 125F during shutdown and refueling.

Corrosion products originating in the feedwater system downstream from the condensate demineralizer and in the reactor will be removed by recirculating a maximum of 25,000 lb per hr of reactor water through a cleanup system.

The 12-in. main steam line will carry 1,000psig-546F saturated steam to the turbine from the reactor. The steam line passes through a continuous concrete tunnel between the two buildings which also encloses and shields the feedwater heaters.

The turbine will be a 50,000-kw, 3,600-rpm, tandem-compound, double-flow condensing unit direct connected to a 70,588-kva hydrogen-cooled generator which is connected through a reduction gear to an air-cooled exciter. The only departure from conventional turbine technology will be the design for operation with saturated steam. Materials are chosen to resist attack by wet oxygenated steam and particular attention is being given to elimination of crevices in which radioactive material may be deposited.

Exhaust steam from the turbine passes to the main condenser which is offset to the side and below the turbine. The condenser will be a fabricated steel horizontal single pass divided water box deaerating type unit of essentially conventional construction with an effective condensing surface of 30,700 sq ft. The aluminum brass tubes will be rolled into silicone bronze tube sheets and also sealed with Neoprene gaskets. If any leakage should occur it would pass inward from the circulating water to the condensate. There is no possibility of contamination of the circulating water from this source. The condenser hot well is a 6,000-

gal storage type suitably baffled to allow decay of short lived radioactivity.

All functions required for normal startup and routine power operation will be accomplished from the control room. The unit will therefore be provided with sufficient remote indicating devices to monitor all important conditions of operation and to permit remote testing under load of both the stop valve and the overspeed governor.

The unit is designed to operate essentially at base load with the turbine initial pressure regulator adjusting the turbine admission valves to maintain reactor pressure. The control rods are manually set by the operator to regulate the reactor power level, void fraction and void distribution. The turbine speed governor is set above the speed required by normal system frequency and, therefore, is not in control of the turbine admission valves.

To prevent the reactor vessel pressure from exceeding its design value, a bypass system and safety valves are provided. The bypass valves open whenever reactor pressure exceeds the full load pressure setting of the initial pressure regulator. The bypass valves are designed to open rapidly enough to relieve the reactor pressure in the event of loss of load at the turbine and without requiring a reactor scram.

Normally the steam bypass valves will be closed and all reactor steam flow will pass through the turbine. Generator output is dependent upon steam flow available. Power output is increased or decreased by adjusting reactor control rods to generate more or less heat, thus changing steam flow.

Sudden loss of electrical load would cause the turbine to overspeed and the speed governor would then override the initial pressure regulator signal which normally controls the turbine admission valves. The admission valves would close sufficiently to limit turbine speed. The reactor pressure would rise until the steam bypass valves open. If the pressure still continued to rise, the reactor would be scrammed and the steam condensed in the emergency condenser.

Air and gas are removed from the condenser by a twin element, two-stage steam jet air ejector with surface inter and after condensers. Ejected gases will be discharged to the main plant exhaust stack through oversize piping which provides a minimum holdup enroute of 18 min. The off gas is continually monitored as it leaves the air ejector to determine whether fission product gases or other radioactive material is entering the off gas line. If the activity level exceeds the safe value, provision is made for closing the valve in this line, thereby preventing discharge of the gas to the stack.

Condensate is discharged from the condenser hotwell by two half capacity vertical centrifugal pumps. It is pumped through the air ejector inter and after condensers, the gland seal condenser, the full flow condensate demineralizers, the low pressure and intermediate feedwater heaters and finally is delivered to the reactor feed pumps. Three mixed bed condensate demineralizers each rated at one half of the total condensate flow remove from the condensate any radioactive materials carried over from the reactor as well as any corrosion or erosion products from the turbine-condenser system. All feedwater system piping is carbon steel except that within the dry well vessel which is type 304 stainless steel.

The turbine auxiliary building contains the main control room and switchgear enclosures. These are shielded from the turbine by concrete walls which are located in the central portion of the operating floor between the turbine shield wall and the refueling building. A turbine laydown and decontamination area is provided at the main operating floor elevation on the east side of the turbine.

The refueling building is a rec-

(*Continued on page 98*)

Nuclear Power Will Cost About 8 Mills/Kwhr

The capital cost of Humboldt Unit No. 3 was initially estimated at $19,500,000 of which the major portion represented a fixed price contract, subject only to escalation for labor and material. Since the contract date, February 1958, escalation has added a million dollars to direct cost and $100,000 to indirect. The capital cost is now estimated to be $20,600,000 divided into these principal accounts:

Structures and Improvements	$2,863,000
Reactor Plant Equipment	8,837,000
Turbine Generator Unit	4,510,000
Accessory Electrical Equipment	704,000
Misc. Power Plant Equipment	286,000
Total Contract Price	$17,200,000
Escalation as of August 1960	1,000,000
	$18,200,000
Interest During Construction & Overhead Construction Costs	2,400,000
TOTAL	$20,600,000

Estimates indicate that the cost of nuclear power from Humboldt Unit No. 3 will be about 8 mills per kwhr with the unit operating at 90% capacity factor and assuming a capability of 60,000 kw. This figure is for the second core and based on the present credit for plutonium produced by the reactor.

Studies show that 8 mill-power is competitive in the Eureka area which is on the Pacific Coast in the northwest corner of California. Humboldt Bay Power plant occupies a 137 acre site on the Buhne Point, about 4 miles southwest of Eureka. It is somewhat isolated from the rest of the PG&E system being supplied by two 50 Mw conventional steam units at Humboldt Bay power plant and by two rather long 110-kv transmission lines. Fuel oil is more expensive in Eureka than elsewhere on the system. These considerations combined to make Humboldt Bay power plant an ideal location at which to install a nuclear unit.

6th Steam Station Design Survey

Examination of significant developments in 73 new plants reveals few radical changes, but trend toward computer control of units expands rapidly

LEON A. ALLEN, JR, Middle Eastern Editor

● Electrical World's Sixth Steam Station Design Survey, examining significant developments in 73 new plants or units, has both confirmed the development of trends unearthed in the last survey (EW, Oct. 6, 1958) and noted the arrival of new design ideas. Plants included in the survey are scheduled for initial operation from 1960 through 1964.

Outstanding developments include:

1. Continued increases in unit size, temperatures, pressures and cross-compounded units.

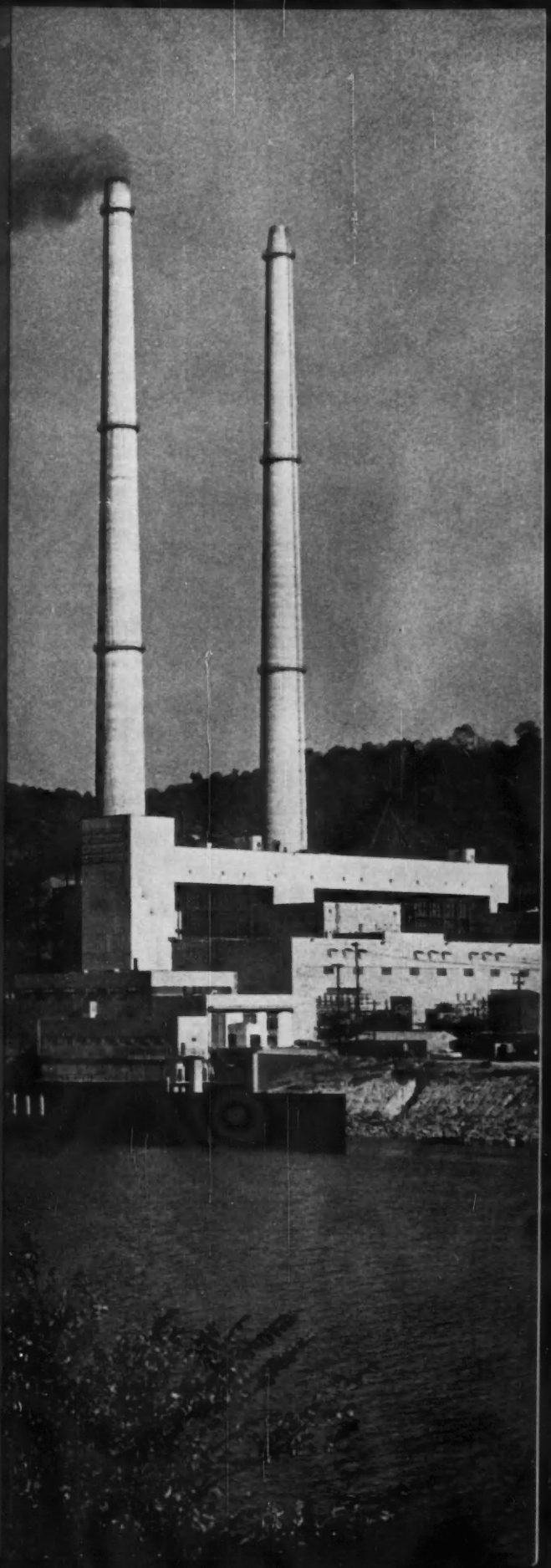
2. Mushrooming growth of the use of heat rate performance computers and data loggers, with a number of outright computer control installations.

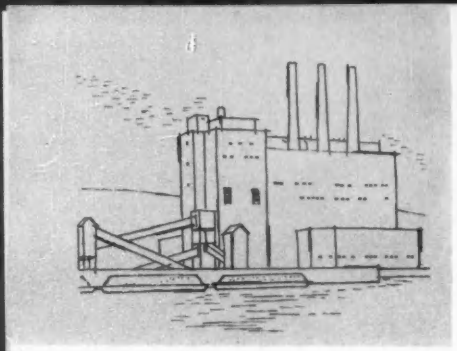
3. Increased reliance on a smaller number of larger boiler feed pumps, with more turbine-driven and shaft-driven pumps.

4. A rise in generator voltage to the point where 13.8 kv has given way to voltages of 18 kv and higher for larger units.

5. An apparent stabilization of the trend toward increased use of outdoor equipment, especially turbines and generators.

Although the short space of two years between surveys usually precludes the observance of abrupt changes in design practices, the trend to computer control of new installations represents the most striking trend in generating station design observed in some time.





General Features

A new plateau in the percentage of plants using outdoor equipment seems to have been reached. Fewer plants reported putting boilers and turbines outdoors than had been the case in the fifth survey. There is no geographic limitation on outdoor boilers—one plant in New Hampshire has an outdoor boiler, while another in Florida has its boiler indoors.

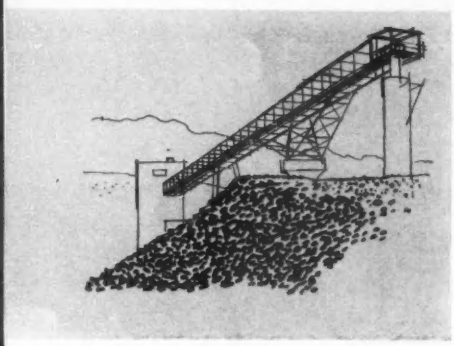
Turbine halls, however, are placed outdoors, with few exceptions, only in the South and Southwest. Low rainfall seems more conducive to placing boilers outside than does a high annual mean temperature. Trends in the use of outdoor equipment revealed in the last three surveys are apparent in the table at right.

New materials are being used for external walls to provide a pleasing appearance. Porcelainized metal and tile are receiving more attention. Brick walls, once standard, continue to decline in popularity, largely because of the high labor cost of construction. Only 12 stations are brick.

Gas-burning stations in the South and West use short steel stacks, while coal-burning plants elsewhere in the country are using the higher concrete stacks. Several plants mentioned the use of steel-lined concrete stacks—the first time this has been mentioned.

A sharp decrease was noted for the first time in the number of units designed for quick load pickup. This is almost certainly due to a change in the wording of the survey question. In the sixth survey, the parenthetical phrase "banked boiler" was inserted to more closely delineate the conditions for quick load pickup. This excluded many stations with provisions for quick load pickup from a hot boiler or spinning turbine condition.

	4th Survey (67 plants)	5th Survey (71 plants)	6th Survey (73 plants)
Boiler	34	43	39
Turbine	16	21	19
Fans	38	55	52
Pumps	11	18	17
Air Heaters	34	45	42
Dust Collectors	33	29	35
Circulating Pumps	28	36	42
Condensers	..	..	12
Pulverizers	..	3	2
Generator	..	26	20



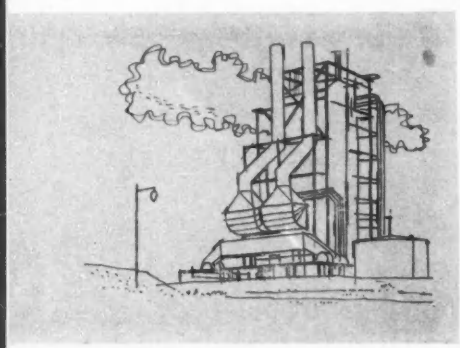
Fuel and Ash Handling

Over the past few years bunker capacities have decreased. This trend continues, although at a decreasing rate. Six years ago, most coal-burning plants reported that they were to be equipped with bunkers having a capacity for 30 to 50 hr operation. Now, over half of the new plants have bunker capacities of 30 hr or less, and five have capacities of less than 10 hr.

Bunker capacity is a function not only of the method of plant operation but also of the coordination between mining and transportation facilities. But steady development in the reliability of coal handling and conveying equipment, permitting operators to fill bunkers readily and keep them filled, and the tendency to rely on the ready coal pile contribute to the use of smaller bunkers. In one plant, provision has been made for the control room operator to control coal flow from the reclaiming hopper to the cyclones. And Con Ed's Ravenswood Plant burns oil piped from storage tanks at a station four miles away.

Over twice as many electrical precipitators were reported in the sixth survey as in the fifth survey. The trend to multi-precipitators continues. A five-fold increase in the use of static rectifiers as a power source for precipitators was reported, although electronic rectifiers still top the list.

A slight increase in the number of utilities selling fly ash was reported, but four out of five still dump it. This relatively poor showing has prevailed since EW first asked this question six years ago.



Steam Generator

Most large units have divided or twin furnaces. However, the largest unit (650 Mw) has a single furnace. The smallest unit having a divided furnace is 125 Mw, and the smallest for a twin furnace is 325 Mw. Divided furnaces are increasing, but the survey revealed a decline in the number of twin furnaces from 11 to eight.

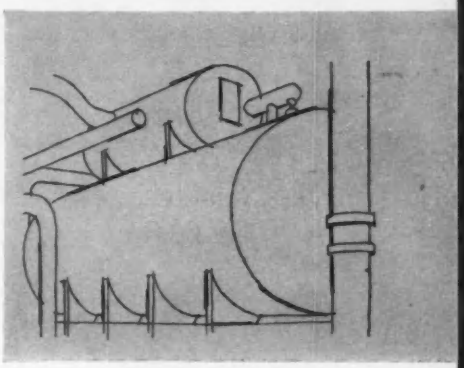
Forty-five units use pressurized furnaces, and the majority burn gas. But a sharp increase is discernible in the number of coal-fired plants using pressurized furnaces. This figure rose from three on the last survey to 18 on the present one. This apparently reflects improvement in design of pressurized furnaces and related equipment and more confidence on the part of operators, as well as economies through reduction in the use of ID fans.

The spray atemperation method is the most frequently used main means of superheat control. Burner tilt is a

close second. Gas recirculation shows a marked increase over the last survey, while the number of damper controls has decreased. A substantial increase was also reported in the number of plants using more than one means of primary control. For emergency or secondary control, designers selected spray control in almost all reported cases.

Reheat temperature control is being achieved in about half of the units with tilting burners. This represents little change from past practice. All but two units are equipped with spray control as the secondary or emergency means of controlling reheat temperature.

Heat Cycle Apparatus

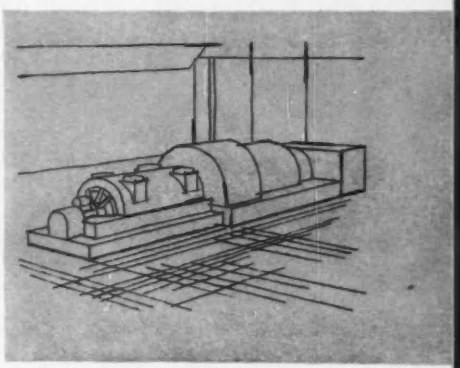


Demineralizers continue to dominate as the means for purifying feed water. In this survey 48 of the 73 reporting units have them. The remainder use evaporators, except that two units use both. Many evaporators are additions to existing units.

Group bypassing of heaters continues as a means of reducing initial investment in bypass piping and valves. Both low and high-pressure heaters are group bypassed in 29% of the installations; 3% have only LP heaters group bypassed; and 22% have just HP heaters group bypassed.

The trend to provide two strings of heaters continues. Twenty-three units have this arrangement. In 11 the design entails both LP and HP heaters. Ten have two strings of HP heaters only, and two have two strings of LP heaters only. Ten units are provided with condensate bypass demineralizers. Size of unit does not appear to influence the decision to have this equipment in the cycle.

Turbine, Generator, Exciter



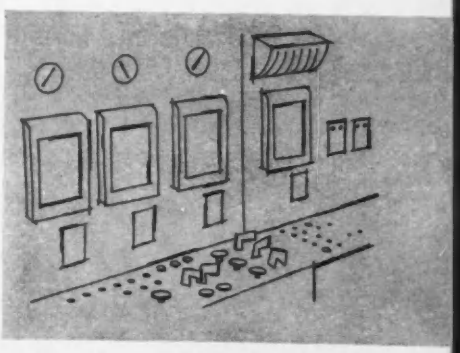
Although tandem-compound units are still the preferred arrangement of turbine elements, the percentage of cross-compound machines continues to increase. Eighteen cross-compound and ten axial flow machines were reported, compared with 14 and 11 respectively in 1958. Only three of the cross-compound units have 3,600 rpm on both shafts. Just two units had their high-pressure sections shipped assembled.

Twenty generators with liquid conductor cooled stators were listed, compared with five two years ago. In addition, there are 12 gas conductor cooled stator machines. Twelve machines, not necessarily different ones, have gas conductor cooled rotors.

For the first time, 13.8 kv is no longer the predominant choice for generator voltage. Just 16 units generate at 13.8 kv, while 19 use 18 kv. In addition, twelve use 20 kv, and five each use 22 and 24 kv.

A majority of main exciters are shaft driven, with auxiliary motors driving most of the rest. Seven exciters are of the static type, however. About 60% of the units have no spare exciter. Accordingly, over two-thirds of the units in the survey are protected against loss of the potential source, protecting the generator.

Control Instrumentation

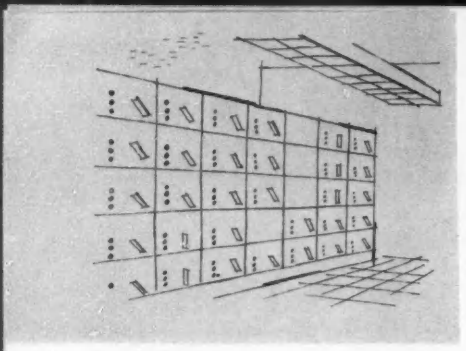


Automation, always prominent in power plant design, is particularly conspicuous this year. In the report 21 units are using data-logging equipment and 16 using heat rate performance computers. These figures compare with seven and two, respectively, from the last survey. Four units are programmed for complete computer control. This, of course, is a trend which will bulk large in future surveys, although it is still too early to estimate the rate of expansion of computer control installations.

Control cables are placed in trays in most stations, with some designers using duct and pipe. Racks are not used to a significant extent. Putting control and power cables in the same tray has become a fairly common practice. Twenty-two installations permit low-voltage cable in the same tray with control cable, and 17 permit both high and low-voltage.

Polyethylene is the most frequently used control cable insulation, but the use of PVC is expanding. Butyl rubber and oil base rubber share this function for power cable. PVC has also increased in sheath use for both control and power cable, although neoprene is still first choice for both.

Leased telephone lines are employed at most stations as a means of communication with the system, but the use of microwave is increasing rapidly. The use of carrier current equipment remains about the same, as most designers are adding microwave, rather than replacing another form of communication with it.



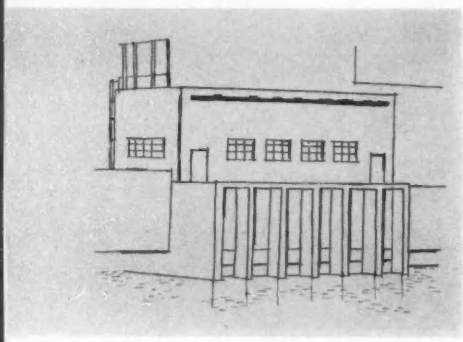
Auxiliaries, Lighting

Seven out of ten auxiliary systems operate at 4,160 v, compared with 57% in the previous survey. The rest use 2,400 v, except for one 6,900-v installation at TVA's 650-Mw Paradise Plant. Motors as large as 400 hp are fed from the low-voltage bus, while 6,000 hp is the largest motor size listed on high voltage buses.

Almost half of the systems are resistance grounded. Ungrounded systems account for about a third, and the rest are solidly grounded. In the past, most systems were ungrounded.

Most installations will be on the unit principle, and accordingly use one auxiliary transformer. However, two and sometimes three auxiliary transformers are used for some of the large units. Instantaneous bus transfer is slightly more popular than time-delay.

Incandescent lighting remains the accepted method for station lighting, although there have been significant increases in fluorescent and mercury lighting since 1958. The popularity of 120/208 v as a lighting voltage is also being challenged by 120/240 v. Also, 13 units will use 277/480 v—an increase of ten over 1958.

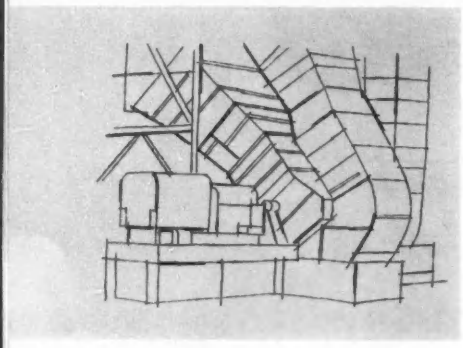


Condenser, Cooling Water

Only 12 of the units (16%) in the present survey have cooling towers. This is eight less than the previous survey. Obviously, this reflects unit location, and does not necessarily indicate a trend. Three cooling ponds were reported. Cathodic protection at the intake or in the condenser is used in 12 and 16 units respectively. Three condensers have insulated tube sheets.

Copper alloys continue to be the accepted material for condenser tubes. But five aluminum and 11 aluminum-brass installations demonstrate the interest in new materials to meet specific situations. Three units have stainless steel condenser tubes.

No cases were reported where tubes were welded to the tube sheet to prevent contamination of feed water by condenser leaks. The hot wells in 24 units, including all size ranges, are compartmentalized in an effort to localize any leaking.

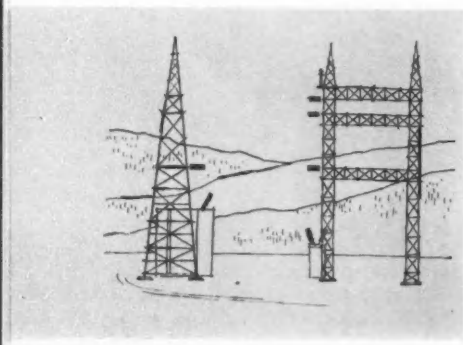


Fans, Pumps, Piping

Motors are still the overwhelming choice for boiler feed pump drives. But ten units use turbine-driven pumps and eight use main shaft-driven pumps. Both represent a considerable increase over previous figures.

Coupled with this trend is the reduction of the number of pumps designers feel should be installed with each unit. In EW's 1956 survey 55% of the installations used three half-capacity pumps; in the 1958 survey two-thirds used two pumps; and in 1960 almost four out of five installations use two pumps. Four use just one full-size pump. Great confidence of designers in the reliability of modern boiler feed pumps is clearly reflected in these figures.

Three-quarters of the plants use mechanical fan couplings—the same ratio that has persisted for the last three surveys. Half of them now eliminate induced draft fans, accompanying a trend toward pressurized boilers.



Outgoing Substation

Nearly all main power transformers are of the FOA type. Isolated FO, FA, and FOW transformers have been specified, though. Nearly all have fire protection, with water the preferred protecting agent.

Sudden pressure relay attachments on main power transformers are used for alarm purposes by 29 utilities, tripping by 26, and both alarm and trip by eight.

The increased reliance on tripping, which can be traced through past surveys, indicates an increased concern with protecting large main power transformers against incipient faults which might lead to an extended loss of capacity.

6th Steam Station Design Check Chart

Design Characteristics of 73 New Plants in the United States

The tables appearing on the following 15 pages are in 3 parts:

1—General Features and Boiler Plant.....pages 78-82

2—Turbine, Generator and Mechanical Equipment.....pages 83-87

3—Electrical Auxiliaries and Control.....pages 88-92

Key to Identification of Plants:

No.	Company	Unit
1.	Tennessee Valley Authority	Paradise Nos. 1 & 2
2.	Commonwealth Edison Co	Will County No. 4
3.	Tennessee Valley Authority	Widow's Creek No. 7
4.	Tennessee Valley Authority	Colbert No. 5
5.	Tennessee Valley Authority	Widow's Creek No. 8
6.	Consolidated Edison Co	Ravenswood Nos. 1 & 2
7.	Consolidated Edison Co	Astoria Nos. 4 & 5
8.	Public Service Electric & Gas Co	Sewaren No. 5
9.	Detroit Edison Co	St. Clair No. 6
10.	Commonwealth Edison Co	Crawford No. 8
11.	Commonwealth Edison Co	State Line No. 4
12.	Commonwealth Edison Co	Waukegan No. 8
13.	Southern California Edison Co	Alamitos Nos. 3 & 4
14.	Union Electric Co	Meramec No. 4
15.	Houston Lighting & Power Co	W. A. Parish No. 3
16.	Wisconsin Electric Power Co	Oak Creek No. 6
17.	Carolina Power & Light Co	Goldsboro No. 3
18.	Georgia Power Co	McDonough No. 1
19.	Los Angeles Dept of Water & Power	Haynes Nos. 1 & 2
20.	Louisiana Power & Light Co	Little Gypsy No. 1
21.	New Orleans Public Service Co	Michoud No. 2
22.	New England Power Co	Brayton Point No. 1
23.	Gulf States Utilities	Sabine Nos. 1 & 2
24.	Houston Lighting & Power Co	T. H. Wharton No. 2
25.	Southern California Edison Co	Huntington Beach Nos. 3 & 4
26.	Virginia Electric & Power Co	Possum Point No. 4
27.	Virginia Electric & Power Co	Portsmouth No. 4
28.	Dallas Power & Light Co	North Lake No. 2
29.	Northern Indiana Public Service Co	Bailly No. 7
30.	Potomac Electric Power Co	Dickerson Nos. 2 & 3
31.	Arizona Public Service Co	Four Corners No. 2
32.	Public Service Co of Oklahoma	Northeastern No. 1
33.	Tampa Electric Co	Gannon No. 3
34.	Ohio Edison Co	Stratton No. 2
35.	Duquesne Light Co	Elrama No. 4
36.	Cincinnati Gas & Electric Co	Miami Fort No. 6
37.	Gulf States Utilities	Willow Glen No. 1
38.	Southwestern Electric Power Co	Wilkes No. 1
39.	Virginia Electric & Power Co	Chesterfield No. 4
40.	Boston Edison Co	Mystic No. 6
41.	Connecticut Light & Power Co	Norwalk Harbor No. 2
42.	Gulf States Utilities	Roy H. Nelson No. 3
43.	Public Service Co of Colorado	Cherokee No. 3
44.	Public Service Co of Indiana	New Albany Nos. 3 & 4
45.	United Illuminating Co	Bridgeport Harbor No. 2
46.	Utah Power & Light Co	Kemmerer No. 1
47.	San Diego Gas & Electric Co	South Bay Nos. 1 & 2
48.	Atlantic City Electric Co	B. L. England No. 1
49.	Columbus & Southern Ohio Electric Co	Conesville No. 3
50.	Iowa-Illinois Gas & Electric Co	Riverside No. 5
51.	South Carolina Electric & Gas Co	Canadys No 1
52.	Texas Power & Light Co	Valley No. 1
53.	Florida Power Corp	Paul L. Bartow No. 2
54.	Arizona Public Service Co	Cholla No. 1
55.	City of Austin, Texas	Holly Street No. 1
56.	Central Louisiana Electric Co	Coughlin No. 6
57.	City of San Antonio, Texas	W. B. Tuttle No. 3
58.	Pacific Power & Light Co	Dave Johnston No. 2
59.	Public Service Co of New Hampshire	Merrimack No. 1
60.	Dairyland Power Cooperative	Alma No. 5
61.	Orlando Utilities Commission, Fla	Indian River No. 1
62.	Interstate Power Co	Fox Lake No. 3
63.	Gulf Power Co	Crist No. 5
64.	Wisconsin Public Service Corp	Weston No. 2
65.	West Texas Utilities Co	Oak Creek No. 1
66.	Delaware Power & Light Co	Delaware City No. 3
67.	Public Service Co of New Mexico	Reeves No. 3
68.	Southern Nevada Power Co	Clark No. 3
69.	Central Illinois Electric & Gas Co	Sabrooke No. 4
70.	City of Colorado Springs, Colo	Martin Drake No. 5
71.	City of Springfield, Mo	James River No. 3
72.	Missouri Public Service Co	Sibley No. 1
73.	City of Gainesville, Fla	Gainesville No. 7

Explanatory Notes:

Plant No.	Item	Note
6	Bunker capacity =? hrs operation	Fuel oil piped from Astoria Station storage 4 miles away
6, 7	Transformer rating	Two 3-phase, 135/180/225-Mva
8	Principal fuels	1. Residual 2. Bunker C
8	External walls	Prestressed concrete panels
8	Furnace	Future wet bottom
8	Heat rate perf computers	Computer controlled
12	Economizer	Cast iron low level economizer
13	Heat rate perf computers	Computer controlled
17	Cooling tower	Cooling pond—water to water heat exchangers
17	Wells for cooling, drinking	Treated river water
19	Plastic pipe	For salt water 4 in. and smaller
19	Equipment outdoors	No structural intertie between boiler and turbine bay
20	Heat rate perf computers	Full automation by computer
23	Spare exciter	Portable, used at two other plants
25	Heaters in throat	None, Unit 3; 2, Unit 4
25	Divided water box	Two-pass, Unit 3; one-pass, Unit 4
25	Cross-compound speeds	(1), Unit 3, (3), Unit 4
25	Side or end outlet exhausts	End, Unit 3; Bottom, Unit 4
25	Length, 3600 rpm last stage blades	4, Unit 3; 23, Unit 4
25	Extraction points	7, Unit 3; 8, Unit 4
25	Heat rate perf computer	Program computer control
28	Soot blowers	Air heaters only
28	Cooling water	Lake water
33	Flyash sold, dumped	Reinjected and sold as slag in bulk
33	Plastic pipe for chem circ	Rubber lined
44	Stack height, ft	Crib house and water treating plant in base of stack below breeching connection
47	Plastic pipe for chem circ	Chlorine feed
51	Water velocity	Variable pitch circ water pump
54	Condenser tubes	Arsenical copper
55	Fuel storage	Fuel oil storage tank, 45,000 bbl
59	Reclaiming	Control room operator controls coal flow from reclaiming hopper to cyclones
62	Heat rate perf computers	Recording annunciator
63	Condenser tubes	Tubes flared at both ends
64	Principal fuels	Some petroleum coke
66	Principal fuels	Primary fuel fluid coke
67	Control center	Placed on line by supervisory control

†Day shift only; no shift personnel other than operators

Abbreviations:

Al	Aluminum	Ins Met	Insulated metal
Al-Br	Aluminum Brass	ID	Induced draft
Bot	Bottom	Lig	Lignite
Conc Blk	Concrete block	Mag Amp	Magnetic amplifier
Cu	Copper	Man	Manual
Cyc	Cyclone	OH	Overhead
Dist Xf	Distribution transformer	Pot Xf	Potential transformer
Fluor	Fluorescent	Prot Met	Protected metal
Fut	Future	Sh Met	Sheet metal
FD	Forced draft	Stat Amp	Static amplifier
Galb	Galbestos	St Steel	Stainless steel

1—General Features and Boiler Plant

Plant Number	1	2	3	4	5	6	7	8	9	10	11	12	13
Capacity of Unit, Mw	650	532	500	500	500	363	357	342	325	325	325	325	310
Estimated Date of Operation	9/62	4/63	9/60	7/62	8/63	3/63	3/61	5/62	4/61	4/61	5/62	6/62	1/62
Steam Pressure (psi)	2400	2400	2400	2400	2400	2000	2000	2400	2400	2000	2000	2000	2400
Steam Temperature (Supht)	1050	1000	1050	1050	1050	1050	1050	1100	1050	1050	1050	1000	1050
Steam Temperature (Reht)	1000	1000	1000	1000	1000	1000	1000	1050	1000	1000	1000	1000	1000
Principal Fuels: (B)itum, (W)ashed, (R)aw, (G)as, (O)il	R	R	W	W	W	OG	WGO	O*	W	WR	W	WO	GO
Hydrogen Cooling Pressure (psi)		30	27/47		45	45	45	45/60	45	45/60	45/60	45/60	30
Plant Operators per Shift per Unit						3.5	3.5	4	3.6				1.75
Plant Personnel Other than Operators (incl maint) per Shift per Unit						2	2	1	0				4.5
Plant Operating Personnel (incl watch engr) per Shift in Control Room						3	3	1	1				1
Generator Kv	24	20	24	24	24	20	20	18	18	12.6	18	18	18
Main Power Transformers per Unit	2	1	2	2	2	2	2	1	1	1	1	1	1
General Features													
Equipment outdoors: (B)lr, (T)urb, (G)en, (F)ans, (P)umps, (A)irhtr, (D)ust coll, (C)irc water pumps, (Co)nd, Pul(v)	D C	FD C	FD C	D C	D C		D	BG FPAD C	FAD	F	D	FD	BTG FPA CCo
Crane, tons, and no. of hooks	125-2	150-1	110-2	110-2	110-2	150-2	200-2	160-2		125-2	75-2	250-3	82-2
Designed for quick load pickup (banked boiler) ____ hr.													
No. of (A)irhtrs, (D)ust coils, (F)ans	1, 0, 4	4, 1, 4	4, 4, 4	5, 4, 4	4, 4, 4	4, 0, 4	4, 2, 4	2, 1, 2	2, 2, 12	4, 2, 2	2, 2, 2	2, 2, 2	2, 0, 2
External walls (A)lum, (B)rick, (C)em-Asb, (P)orcelanized metal	P	Ins Met	A	C	A		B	*	A	P	P	St Sht	Conc Blk
Stacks (B)rick, (C)oncr (S)teel	C	C	C	C	C	S	S	C	CS	C	S	CS	C
Stack foundation on (B)lr, (G)round elev.	G	G	G	G	G	B	B	G	G	G	B	G	G
Stack height in feet	600	500	500	500	500	185	315	325	425	378	450	450	200
Fuel and Handling													
Fuel Delivery (R)ail, (B)arge, (T)ruck, (P)ipe, B(e)lt, (S)elf unloading boat	T	B	RBT	B	RBT	P	B	BP	S	B	R	R	P
Unloading: (R)otary car dumper, car (V)ibrator, (Q)uick unloading car (G)antry, (B)oomcrane		G	RG		RG		G		B	B	R	R	
Storage: (L)oco, (G)antry, (E)arthmoving	E	GE	E	E	E		G		E	E	E	E	
Recl'm'g: (L)oco, (D)rag, (E)arthmoving	E	E	E	E	E				E	E	E	E	
No. of Bunkers per Boiler	2	1	1	1	1		1		1	2	2	6	
No. of Pulv per Boiler	Cyc-14	8	10	10	10		8		8	8		6	
Pulverizer type B(a)ll, B(o)wl, (A)ttrition		o	o	a	o		o		o	o			
Bunker chutes: (S)traight, S(t)ainl's (V)ib	t	SVt	t	t	t		t		S	S	S	tS	
Bunker outlets: (S)trt, S(t)nlss (A)irbags		t					t		S	S	S		
Bunker capacity = ? hrs operation	13	27.5	28	28.5	28	*	36		29	25	29	26	
Small bunkers with ready coal pile	Yes												
Steam Generator													
Burner area (I)ndoor, (O)utdoor	I	I	I	I	I	I	I	O	I	I	I	I	O
Furnace: (S)ingle, (T)win, (D)ivided	S	T	T	D	T	T	T	S	T	T	SD	T	D
Firing: (H)or, (V)ert, (Tu)rb, (Ta)ng, (C)yc	C	Ta	Ta	H	Ta	Ta	Ta	H	Ta	Ta	C	Ta	Ta
Pressurized furnace, in.	27	14		15	18	16	16	38			20	29	19
Supht contr-main-(D)amp, (B)urner, (S)pray, (G)as recirculation, (C)ond	B	B	B	B	B	B	B	firing	B	B	DG	B	B
Supht contr-secondary or emerg-(D)amp, (B)urner, (S)pray, (G)as recirc, (C)ond.	G	S	S		S	S	S	G	S	S	S	S	SG
Reheat contr-main-(D)amp, (B)urner, (S)pray, (G)as recirculation, (C)ond	B	B	B	S	B	B	B	D	B	B	DG	B	B
Reheat contr-secondary or emerg-(D)amp, (B)urner, (S)pray, (G)as recirc, (C)ond.	S	S	S		S	S	S		S	S	S	S	S
Circ (N)atural, (F)orced, (O)nce-thru	O	F	F	O	F	F	F	O	F	F	N	F	F
Furn platens for (W)alls, (S)upht, (R)ehtr	S	S	SR	SR	SR	WS	WS	S	SR	SR	SR		SR
Gas Temp leaving furnace, F	2250	1900	1995	2050	1995	1900	1900	645	2090	1930		1930	627
Automatic burner control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
Heater air preheated		Yes				Yes	Yes	Yes	Yes	150F	150F	Yes	Yes
Ash Control and Disposal													
Furnace (D)ry, (W)et bottom	W	D	D	D	D	D	D	W*	D	D	W	D	D
Soot-blowers (A)ir, (S)team (A)uto seq	AA	A	SA	AA	S	SA	SA	AA	AA	SA	SA	AS	AA
(M)ech, (E)lec collectors		E	E	E	E		ME		ME	E	E	E	
Prec rect (R)otary, (E)lectronic, (S)tatic		E	E	E			E		E	E	S	S	
Bottom ash sluiced	Yes	Yes	Yes	Yes	Yes		Yes		Yes	Yes		Yes	
Flyash (S)old, (D)umped	D	SD	D	D	D		D		SD	SD	S	SD	
Flyash sold (B)ulk, (P)ackaged for (C)ement, (A)sph filler		B							B	B	B	B	

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
300	275	275	253	250	230	230	227	225	220	220	210	200	200	175	175	175
5/61	1/61	61	5/62	5/63	8/62	2/60	2/63	5/63	3/62	5/60	12/60	3/62	5/62	1/62	12/62	5/60
2000	2125	2425	2400	2400	2000	2000	2000	2400	1800	2000	2400	2400	2400	1800	2400	2400
1000	1005	1050	1000	1000	1000	1000	1000	1000	1000	1000	1050	1000	1000	1000	1000	1050
1000	1005	1000	1000	1000	1000		1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
W	GO	W	W	R	GO	G	GO	W	GO	GO	GO	WO	WO	GO	WG	WR
30/45/60	30/45	15/30/45/60	45/60	30/45	30/45	30/45	15/30/45	0.5/15/30	30/45/60	45/60/75	30	0.5/30/45	0.5/30/45	30/45/60	15/30	0.5/15/30
5	3.67	3			2.5	3	1.5	3		2	1.75	2.5	2.25	2		2
4	0	5			7	21†	1.16	2		0	4.5	0	0	7.5		5
0	2	2			2	2	0.5	1		2	1	2	2	1.5		3
	24		18	20	18	22	18	18	20	20	13.8	22	22	18	22	13.8
2	2	1	3	1	1	1	1	2	1	3	3	1	1	1	1	1
FAD	BTG FPA CCo	FD	BTG FPAD CCo	D	BTG FA C	BTG PA CCo	BTG FPA CCo	FAD C	B FA C	BTG FPA CCo	BTG FPA CCo	B FAD C	B FAD C	BTG FPA CCo	D	
125-2	55-2	85-2	70-2	60-2	60-3	60-2	50-2	100-2	60-2	55-2	60-2	100-2	100-2	50-2	75-1	200-2
						5										
2, 2, 4	2, 0, 2	3, 1, 4	2, 1, 4	2, 2, 2	2, 0, 2	2, 0, 2	2, 0, 2	2, 1, 4	2, 0, 2	2, 0, 2	2, 0, 2	2, 1, 2	2, 1, 2	2, 0, 2	2, 2, 2	2, 1, 4
Steel	Steel	A	P	A	A	P		A	Galb	Steel	C	C	C	AB		C
C	S	C	C	S	S	S	S	C	S	S	C	B	B	S	CS	C
G	G	G	G	B	G	B	B	G	B	B	G	G	G	B	G	G
350	180	450	300	100	240	161.5	187	350	137	73	200	175	175	164	400	400
BR	RTP	S	R	R	TP	PB	PB	BS	RP	RPT	P	RB	R	PT	RT	RT
VB			V	R				B				V	V		R	R
E		E	E	E				E				E	E		E	E
E		E	E	E				E				E	E		E	E
1		2	5	5				4				1	1		4	1
3		2	5	5				4				4	4			4
a		a	A	o				o				o	o			o
tS		S	S	tV				t				V	V		V	S
S		S	S	t				tW				t	t			t
24		30	30	25				7				26	26		36	42
								Yes								
I	O	I	O	I	I	O	O	I	O	O	O	O	O	O	I	I
SD	S	D	S	D	S	S	S	D	D	D	D	D	D	S	S	D
H	H	V	H	Ta	H	Tu	Tu	Ta	Ta	Ta	H			Tu	C	Ta
	9.3			20	10	22	9.45		8.2	9.85	8.7			8.5	30	−0.1
S	C	B	S	B	GS	D	S	S	BS	B	firing	B	B	D	G	B
D				S	S	S		B		S	G	S	S	DS	S	S
D	D	B	D	B	G	D	D	B	BS	B	D	B	B	D	G	B
	S		S	S	S	S	S	S		S		S	S	DS	S	S
N	N	N	N	F	N	N	N	F	F	F	O	F	F	N	N	F
S		WS	S	S	SR	W	S	SR	SR		S	W	W	W		S
1730	2230	845	1960	665	2200	1970	2085		2000	2160		1930	1930	1890	1750	2225
Yes			Yes		Yes			Yes	Yes		Yes	Yes	Yes			Yes
Yes			Yes	Yes				Yes			Yes	Yes	Yes	Yes	Yes	Yes
D	D	D	D	D	D			D	D	D	D	D	D	D	D	D
SA		SA	AA	SA	SA			AA			AA	SA	SA	S*	A	S
E		E	M	E				E				E	E		E	E
E		S		S				E				E	E		E	E
Yes			Yes	Yes				Yes				Yes	Yes		Yes	Yes
SD		SD	D					D				D	D		*	D
B		BA														

1—General Features and Boiler Plant

Plant Number	31	32	33	34	35	36	37	38	39	40	41	42	43
Capacity of Unit, Mw	175	175	175	173	172	168	162	160	158.5	157.5	150	150	150
Date of Operation	1/63	2/61	10/60	7/60	10/60	11/60	3/60	4/63	6/60	5/61	9/62	3/60	4/62
Steam Pressure (psi)	1800	2000	1800	2400	1800	2400	1800	1800	2400	1800	2000	1800	1925
Steam Temperature (Supht)	1000	1005	1000	1050	1000	1050	1000	1000	1000	1000	1000	1000	1005
Steam Temperature (Reht)	1000	1005	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1005
Principal Fuels: (B)itum, (W)ashed, (R)aw, (G)as, (O)il	R	GO	WR	R	WR	RW	GO	G	WO	WO	WR	GO*	R
Hydrogen Cooling Pressure (psi)	30/45	30/45/60	15/30/45	0.5/15/30	30/45/60	30	30/45	45	0.5/30/45	30	15/30/45	0.5/30	30/45/60
Operators per Shift per Unit		3	2.66	3.5	3.5	4	2		2.5	3	2.5	2	3
Plant Personnel Other than Operators (incl maint) per Shift per Unit			6	18			0	9†	17.75†	2			3.2
Plant Personnel per Shift (incl watch engr) in Control Room		2	1	3	3	2	1	2	2	2	3	1	3
Generator Kv		14.4	20	20	18	18	18	18	22	18	20	18	20
Main Power Transformers per Unit	1	1	1	1	1	3	1	2	1	1	1	1	1
General Features													
Equipment outdoors: (B)lr, (T)urb, (G)en,	TG	BTG	B				BTG	B	B			BTG	BF
(F)ans, (P)umps, (A)irhtr, (D)ust coll,	FAD	P	FAD			FD	FPA	F	FPAD	FD	FD	FA	AD
(C)irc water pumps, (Co)nd, Pul(v)	CCo	C	C				C	C	C			C	C
Crane, tons, and no. of hooks	50	75-2	150-2	200-2		110-2		60-2	100-2	125-2	150-2	60-2	200-2
Designed for quick load pickup (banked boiler)_____hr.									2				
No. of (A)irhtrs, (D)ust colls, (F)ans	2, 2, 4	1, 0, 2	2, 1, 2	2, 1, 4		2, 1, 2	2, 0, 2	2, 0, 2	2, 1, 2	2, 1, 4	2, 1, 4	2, 0, 2	2, 1, 2
External walls (A)lum, (B)rick, (C)em-Asb, (P)orcelanized metal	P		C	AB	A	B	Steel	B	C	AB	P	C	C
Stacks (B)rick, (C)oncr (S)teel	BC	S	S	C	S	S	S	S	B	CB	C	S	C
Stack foundation on (B)lr, (G)round elev	G	B		G	B	B	B	B	G	G	G	B	G
Stack height in feet		183	200	500	76	375	196.5	162	200	335.5	350	196.5	300
Fuel and Handling													
Fuel Delivery (R)ail, (B)arge, (T)ruck, (P)ipe, B(e)lt, (S)elf unloading boat		P	RS	TB	RBT	B	PB	P	R	PR	B	RBTP	R
Unloading: (R)otary car dumper, car (V)ibrator, (Q)uick unloading car (G)antry, (B)oomcrane	V		V	G	VB	B			V	V	B		V
Storage: (L)oco, (G)antry, (E)arthmoving	E		E	E	E	E			E	E	E		E
Recl'm'g: (L)oco, (D)rag, (E)arthmoving	E		E	E	E	E			E	E	E		E
No. of Bunkers per Boiler	3		1	1	1	1			1	4	1		4
No. of Pulv per Boiler	3			5	5	5			4	4	4		4
Pulverizer type B(a)ll, B(o)wl, (A)ttrition	a			o	A	o			o	o	o		A
Bunker chutes: (S)traight, S(t)ainl's (V)ib			S	S	t	S			tV	V	SV		S
Bunker outlets: (S)trt, S(t)nlss (A)irbags			t	S	t	St			St	S	S		S
Bunker capacity = ? hrs operation			32	48	49	39			40	40	60		28
Small bunkers with ready coal pile													
Steam Generator													
Burner area (I)ndoor, (O)utdoor	O	O	I	I	I	I	O	O	O	I	I	O	I
Furnace: (S)ingle, (T)win, (D)ivided	S	S	S	D	D	S	S	S	D	D	D	S	D
Firing: (H)or, (V)ert, (Tu)rb, (Ta)ng, (C)yc	H	H	C	H	H	Ta	Ta	Ta	Ta	Ta	Ta	Ta	H
Pressurized furnace, in.	0.10	16	12				8	25		0.15		10	
Supht contr-main-(D)amp, (B)urner, (S)pray, (G)as recirculation, (C)ond	S	S	G	GC	G	BS	BS	B	B	BS	S	S	SG
Supht contr-secondary or emerg-(D)amp, (B)urner, (S)pray, (G)as recirc, (C)ond.		S	S		S	S		S	S		S	B	
Reheat contr-main-(D)amp, B)urner, (S)pray, (G)as recirculation, (C)ond	D	S	SG	D	G	B	BS	B	B	BS	B	B	SG
Reheat contr-secondary or emerg-(D)amp, (B)urner, (S)pray, (G)as recirc, (C)ond		S	SG		S	S		S	S		S	S	
Circ (N)atural, (F)orced, (O)nce-thru	N	N	N	N	N	F	N	N	F	F	F	N	N
Furn platens for (W)alls, (S)upht, (R)ehtr			W	S	SR	SR		SR	WSR	W	S	W	SR
Gas Temp leaving furnace	1950	330	300	2055	300	2050	290	2375	2050	610	2060	640	727
Automatic burner control	Yes	Yes				Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Heater air preheated	Yes		Yes	Yes	Yes	Yes	Yes		Yes				
Ash Control and Disposal													
Furnace (D)ry, (W)et bottom	D		W	D	D	D			D	D	D		D
Soot-blowers (A)ir, (S)team (A)uto seq	A		SA	A	SA	A			SA	S	AA		AA
(M)ech, (E)lec collectors	M		E	E	ME	ME			E	E	ME		M
Prec rect (R)otary, (E)lectronic, (S)tatic			S	S	E	E			E	S	E		
Bottom ash sluiced			Yes	Yes	Yes	Yes			Yes		Yes		Yes
Flyash (S)old, (D)umped	D		*	SD	SD	D			D	D	D		D
Flyash sold (B)ulk, (P)ackaged for (C)ement, (A)sph filler				B	B								

44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
150	150	150	136.5	125	125	125	125	125	121	115	100	100	100	100	100	80
60/61	8/61	10/63	60/62	11/62	62	5/61	4-62	12-62	7/61	6/62	7/60	4/61	5/61	11/60	10/60	1/60
1800	2000	1800	2000	1800	1450	1800	2400	1800	1800	1800	1450	1450	1585	1450	1800	1450
1000	1000	1000	1000	1005	1000	1000	1050	1000	1000	1000	1000	1000	1005	1000	1000	1000
1000	1000	1000	1000	1005	1000	1000	1000	1000	1000	1000	1000	1000	1005	1000	1000	1000
W	RO	R	GO	W	R	WG	R	GO	GO	R	GO	G	GO	RGO	WO	WR
45/60	15/30/45	0.5/15/30	0.5/15/30	30	45/60	30	30	30-45	0.5/15/30	30/45	0.5/15/30	45/60	0.5/15/30	30	5/15/30	15/30
2.25	3	3	2	5	3	2	2	3	3	3	4		2	1	3	2
20.25†				27†	1	1			19†	26†	1		5.67	8	8	1
6	2	1	2	3	3	2	1	1	2	3	1		3	2	2	2
18	20	18		15	18	15		20	15.5	13.8	13.8	13.8	13.8		14.4	14.4
1	1	1	1	2	1	1	1	1	2	1	1	1	1	1	1	1
	B	B	BTG	B	BTG		B	BTG		BTG	B	BTG	B	BTG	B	
FA	FAD	FAD	PA	F	FPAD	F(ID)	FAD	FPA	F	FPAD	FA	FPA	FA	FAD	AD	
		C	C	C	C		Cv	CCo	C	CCo		CCo	C	C		
150-2	50-2	55-2	50-2	50-2	50-2	100-2	40-2	50-1	100-2	50-2	100-2	40-1	40-2	50-2	50-2	60-2
										3					1.5	
2, 2, 2	2, 2, 2	2, 2, 2	2, 0, 2	2, 1, 2	2, 2, 2	2, 1, 4	2, 0, 0	2, 0, 2	2, 0, 4	2, 2, 4	1, 0, 2	2, 0, 2	2, 0, 2	2, 1, 4	2, 1, 2	2, 2, 2
A	C	C	Conc	AB, Blk	Tile	A	A		Tile		Galb		B	A	A	BC
C	C	S	S	C	C	SB	C	S	C	BC	S	S	S	CB	CB	S
G	G	G		G	G	Roof	G	B	G	G	B	B	B	G	G	B
575*	250	200	175	250	450	346	200	142	300	250	153	119	150	250	225	71
B	RT	e	BP	R	TB	RP	R	PT	PS	R	PTR	P	PR	T	R	B
B	V			V		V	V			V					V	GB
E	E	E		E	E	E	E			E				E	E	E
E	E	E		E	E	E	E			E				E	E*	E
3	5	4		1	4	1	4			4				6	3	4
3		4		3 Cyc	4	4	4			4				6	3 Cyc	4
		o			o	o				o				a		A
SV	t	S		StV	St	S	S			S				S	SV	S
S	t	S			t	t	A			S				St	SA	T
32	30	8		40	24	31	12			45				30	45	16
Yes		Yes					Yes									
I	I	O	O	I	I	I	O	O	I	O	O	O	I	I	I	I
D	S	S	S	S	S	S	D	D	S	S	S	S	S	S	S	S
H	C	Ta	H	C	H	Ta	Ta	H	Ta		Ta	H		H	C	H
	12		17.5	27-32	9.5	−0.15		19			10.25	25	10		20	
D	SG	S	SG	SG	S	B	B	DS	GS	S	S		G	S	G	D
S		B			S	S	S	DS	S		B	S	S	BD	S	S
D	SG	B	SG	SG	S	B	B	DS	B	B	B		G	S	G	D
D		S			S	S	S	DS	S	S	S	S	S	BD	S	S
N	N	N	N	N	N	N	F	N	N	N	N	N	N	N	N	F
W	WSR	S		WR	W	W		W		SR	W				W	
690	705	1895	709	2150	715	1950			2030		1520	2260	2350	1725	850	680
Yes	Yes	Yes	Yes		Yes	Yes			Yes	Yes	Yes		Yes	Yes	Yes	
Yes		Yes			Yes	Yes			Yes	Yes			Yes	Yes	Yes	
D	W	D	D	W	D	D	D		D	D				D	W	D
A	S	AS	SA	S	A	AA	A		S	AA				A	SA	SA
ME	E	M		E	M	M	M			M				M	E	M
E	S			S											S	
Yes	Yes	Yes		Yes	Yes	Yes	Yes			Yes				Yes	Yes	Yes
D	D	D		Refired	D	D				D				D	D	D

1—General Features and Boiler Plant

Plant Number	61	62	63	64	65	66	67	68	69	70	71	72	73
Capacity of Unit, Mw	78.5	75	75	75	75	66	66	66	55	44	44	44	22
Date of Operation	2/60	7/62	3/61	11/60	3/62	11/61	8/62	7/61	6/61	10/62	3/60	7/60	6/61
Steam Pressure (psi)	1800	1450	1800	1450	1450	1250	1250	1250	1450	1250	1250	1250	900
Steam Temperature (Supht)	1000	1000	1000	1000	1000	950	950	950	1000	950	950	950	900
Steam Temperature (Reht)	1000	1000	1000	1000	1000				1000				
Principal Fuels: (B)itum, (W)ashed, (R)aw, (G)as, (O)il	O	GO	WG	WG*	GO	GO*	GO	GO	WG	G, Lig	RG	W	GO
Hydrogen Cooling Pressure (psi)	30	0.5/15/30	30	0.5/30	30	0.5/30	0.5/15/30	0.5/15/30	30	15/30/95	0.5/15/30	0.5/15/30	0.5/15/30
Operators per Shift per Unit	5	0.67		1	2	3	4		2	3	2	1	
Plant Personnel Other than Operators (incl maint) per Shift per Unit				3	10†	12†	5	18†			9†	4†	
Plant Personnel per Shift (incl watch engr) in Control Room	3			3	2	3	2	1		2	2	1	
Generator Kv	13.8	13.8	13.8		13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	12.5
Main Power Transformers per Unit	1	1	1	1	1	1	1	1	1	1	1	1	
General Features													
Equipment outdoors: (B)lr, (T)urb, (G)en,					B	B	B	B			B	B	
(F)ans, (P)umps, (A)irhtr, (D)ust coll,		F	FD		FA	FAD	FA	FA	FAD		FAD	FA	
(C)irc water pumps, (Co)nd, Pul(v)	C									C	C	C	
Crane, tons, and no. of hooks	150-2		75-2	150-2	50-2		50-1	30-2	60-1	35-2	75-2	125-1	40-2
Designed for quick load pickup (banked boiler)_____hr.								1					
No. of (A)irhtrs, (D)ust colls, (F)ans	2, 0, 2	1, 0, 1	2, 1, 1	2, 2, 2	1, 0, 1	1, 1, 2	1, 0, 0	1, 0, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 0, 1	1, 0, 2
External walls (A)lum, (B)rick, (C)em-Asb, (P)orcelanized metal	Stnless Steel, P	Prot Met	C	A	BP	A	A	Conc Blk	B	B, Galb	Steel	Galb	Prot Met
Stacks (B)rick, (C)oncr (S)teel	S	S	C	S	S		S	S	C	S	C	S	B
Stack foundation on (B)lr, (G)round elev.	Bldg	G	G	B	B		B	B	G	B	G	B	G
Stack height in feet	32		184	75	37		116	156		112	200	30	200
Fuel and Handling													
Fuel Delivery (R)ail, (B)arge, (T)ruck, (P)ipe, B(e)lt, (S)elf unloading boat	T	PR	BP	R	P	eP	PR	P	R	T	RP	R	PT
Unloading: (R)otary car dumper, car (V)ibrator, (Q)uick unloading car (G)antry, (B)oomcrane	Pump		B	V					V		V	V	
Storage: (L)oco, (G)antry, (E)arthmoving			E	E		E			E	E	E	E	
Recl'm'g: (L)oco, (D)rag, (E)arthmoving			E	E		E			E	E	E	E	
No. of Bunkers per Boiler			1	1		1			2	3	3	1	
No. of Pulv per Boiler			4	3		2			2	3	3		
Pulverizer type B(a)ll, B(o)wl, (A)ttrition			o	o		A			o	A	A		
Bunker chutes: (S)traight, S(t)ainl's (V)ib			tV	S		S			V	S	t	t	
Bunker outlets: (S)trt, S(t)nlss (A)irbags			St	S		S			S	S	t	t	
Bunker capacity = ? hrs operation			30	24		50				52	30	32	
Small bunkers with ready coal pile											Yes		
Steam Generator													
Burner area (I)ndoor, (O)utdoor	I	I	I	I	I	I	O	O	I	I	I	I	I
Furnace: (S)ingle, (T)win, (D)ivided	S	S	S	S	S	S	S	S	S	S	S	S	S
Firing: (H)or, (V)ert, (Tu)rb, (Ta)ng, (C)yc	Ta	H	C	H	H	V	H	Ta	H	H	H	C	H
Pressurized furnace, in.	8	10			12		25	7				10.5	
Supht contr-main-(D)amp, (B)urner, (S)pray, (G)as recirculation, (C)ond	S	D	S	G	S	S	S	B	B	S	S	S	
Supht contr-secondary or emerg-(D)amp, (B)urner, (S)pray, (G)as recirc, (C)ond.	S	S		S				S	S		G		
Reheat contr-main-(D)amp, (B)urner, (S)pray, (G)as recirculation, (C)ond	B	D	B	G	S				S				
Reheat contr-secondary or emerg-(D)amp, (B)urner, (S)pray, (G)as recirc, (C)ond.	S	S	S	S									
Circ (N)atural, (F)orced, (O)nce-thru	N	N	N	N	F	N	N	N	N	N	F	N	N
Furn platens for (W)alls, (S)upht, (R)ehtr	S	W			W	W							
Gas Temp leaving furnace	1400	2000	244	1960	234	2330	700	710		1950	260	1800	
Automatic burner control	Yes		Yes		Yes	Yes		Yes	Yes		Yes		Yes
Heater air preheated	Yes		Yes	Yes	Yes	Yes		Yes		Yes	Yes	Yes	Yes
Ash Control and Disposal													
Furnace (D)ry, (W)et bottom		D	D	D		D			D	W	D	W	
Soot-blowers (A)ir, (S)team (A)uto seq		S	SA	S					SA	SA	S	SA	
(M)ech, (E)lec collectors			M			M			E	M	M		
Prec rect (R)otary, (E)lectronic, (S)tatic									E		S		
Bottom ash sluiced		Yes	Yes	Yes		Fut			Yes	Yes	Yes	Yes	
Flyash (S)old, (D)umped		D	D			Reinj			D	D	D		
Flyash sold (B)ulk, (P)ackaged for (C)ement, (A)sph filler													

2—Turbine, Generator and Mechanical Equipment

Plant Number	1	2	3	4	5	6	7	8	9	10	11	12	13
Heat Cycle Apparatus													
Makeup (E)vap, (D)emin	E	D	E	E	E	D	E	D	D	D	D	D	E
FW solids held to.....ppm; pH.....		500/10.5-11				0.1/9.0	0.1/9.0	0.15/9.0	1/8.8-9.2	0.5/8-9	0.5/8.5-10.5	0.5/8-9	0.1/9
Economizer pH at		10.5-11				9.0	9.0		9	9	9	8.5	9.0
Final FW temp at capability	528	534	531	528	527	490	480	532	450	473.6	485	485	516
Demineralizer condensate by-pass	Yes			Yes				Yes				Yes	
Oxy scavenger: (H)ydra, (S)ulf, (M)orpho	H	SM	H	H	H			H	H	M	M	SMH	H
FW htrs group by-passed (H)P, (L)P, (N)ot	HL	H	HL	HL	HL		L	HL	H	H	H	H	
Two strings of (H)P, (L)P heaters	HL	HL	HL	HL	HL	H	H	HL	H	H	H	H	
Feed pump handles (H)ot, (C)old water...	H	H	H	H	H	H	H	H	H	H	H	H	C
Condensing, Cooling Water													
Cooling (T)ower, (I)nduced, (F)orced draft													
Cooling tower for supplementary cooling													
Cooling water (F)resh, (S)alt, (B)rackish	F	F	F	F	F	S	S	S	F	F	F	F	S
Wells for (C)ooling, (D)rinking		D											
Plastic pipe for chem circ		Yes				Yes	Yes		Yes				
Corrosion protection at (I)ntake, in (C)ondenser, insulated (T)ube sheets...		I											TC
Condenser													
Heaters in throat (No.)		4		2				4	2				
Deaeration in (O)pen FW htr, (C)ond	O	O	O	O	O	OC	OC	C	C	OC	OC	O	OC
Divided water-box (T)wo-pass (O)ne-pass	O	O	O	O	O	O	O	O			O	O	T
Cond tubes (Al)um, (Ad)miralty, (C)u-Ni, (S)tainless, (W)elded to tube sheets...	Ad-C	Ad	Ad	Ad-C	Ad	Al-Br W	Al-Br W	Al-Br	Ad	Ad	Ad-S	Ad-S	Al-Br
Hot well compartmentized	Yes		Yes	Yes	Yes	Yes	Yes	Yes					Yes
Reverse flow cleaning		Yes								Yes			Yes
Condenser air removal system, Hogging jet (S)team, (A)ir, (V)acuum pump	V	S	S	V	V			V	V	S	S	SV	SV
Water velocity, fps	7	7	7	7	7	6	6	6.25	7	7	6.95	7	7
Fans and Pumps													
FD/ID fans per boiler (No. ea)	4/0	4/0	4/4	4/0	4/0	4/0	4/0	2/0	2/2	2/2	2/0	2/0	2/0
Fan couplings (H)ydr, (E)lec, (M)ech	H	M	HM	H	H	M	M	H	M	HM	M	H	H
Vane control for fans		Yes	FD only			Yes	Yes		FD only	FD only	Yes		
Feed pumps per boiler (No.)	2	3	2	2	2	2	2	2	2	2	2	2	2
(F)ull, (H)alf size feed pumps	H	H	H	H	H	IF, IH	IF, IH	H	H	H	H	H	IF, IH
Feed pump full-load speed, rpm	5500	5460	6600	6600	6600	3600	3600	6680	3490	3480	3480	2300	3510
Feed pump drive (M)otor, (T)urb, (G)ear, Main turbine (S)haft	T	T	T	T	T	F-S/H-M	F-S/H-M	S	M	M	M	MS	S
Pumps for forced circ (No.), (I)nj seals, (W)et or (H)erm sealed motor drive		4H	I		H	4I	4I		H	4I		4H	4H
Standby pumps, No./size		1-half		1-⅓		1-half	1-half	1-⅓		1-1⅓	1-⅓		1-half
Piping and Valves													
Main stm lne (F)orgd & bord, (H)ol frgng, (S)eamless, (W)eld seam, (C)entrif-cast	F		F	H		H	H	H	H	F	F	F	F
Reht stm lne (F)orgd & bord, (H)ol frgng, (S)eamless, (W)eld seam, (C)entrif-cast	W	W	W	W		W	W	H	H	W	W	SW	W
Main stm (F)erritic, (A)ustenitic	F	F	F	F	F	F	F	A	F	F	F	F	F
Reheat stm line (F)erritic, (A)ustenitic..	F	A	F	F	F	F	F	F	F	F	F	F	F
Valve betw suprhtr & turb stop omitted..	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes			Yes	Yes
Freeze up averted by (R)outing (E)lec ht	R	R				R	R	R	R	RE	RE	RE	
Insul of Ht pipe (M)ineral, (A)lum shell	A	M	MA	M	MA	MA	MA	M	M	MA	MA	M	MA
Turbine													
(A)xial-flow, (T)andem, (C)ross-comp	C	C	C	C	C	C	C	C	C	C	C	C	AC
Cross-comp spds (3)600/3600, 3600/(1)800	1	1	1	3	3	1	1	3	1	1	1	1	1
Side or end outlet exhausts		Bot							Side	Side	Side	End	End
Flow (O)pposed, (D)ouble, (T)riple, (Q)uad	Q	Q	D	Q	Q	OD	OD	Q	D	OD	OD	OD	Axial
Therm prot when motoring	Spray	Yes	Yes	Yes					Yes	Yes		Yes	Yes
(H)P, (L)P unit shipped assembled								H					
Length, 3600 rpm last stage blades, in...	38		43	25	22.5			28		7¾	6.6	7¾	50
No. of extraction points	8	7	8	8	8	7	7	8	7	7	7	7	8
Generator													
Stator cooling (G)as, (L)iq; (D)ucts, (C)ond	L	L	L	L	L	LC	GC	G	C	G	GD	G	G
Rotor cooling (G)as; (D)ucts, (C)ond	GC	G	GC	GC	GC	GC	GC	G	C	G	GC	G	G
Prot for (L)oss of field, (N)eg seq cur..	L	LN	L	L	L	L	L	LN	LN	LN	LN	LN	LN
Neut grd (R), (X), (D)bn tsf (G)rd flt neut	D	D	D	D	D	D	D	R	RD	R	D	D	D
Generator shipped assembled								Yes			Yes	Yes	Yes

2—Turbine, Generator and Mechanical Equipment

Plant Number	14	15	16	17	18	19	20	21	22	23	24	25	26
Heat Cycle Apparatus													
Makeup (E)vap, (D)emin	D	D	D	E	D	E	D*	E	ED	D	D	D	E
FW solids held to.....ppm; pH	0.05/8.4	0/7	—/10	1.0/10	—/9.2	10/8.7-8.9		0.5/8.8-9.2	0.5/8.9	1/8.5	0/7	0.25/9	1/8.8
Economizer pH at	8.4	7	10			8.7-8.9	9	8.8-9.2	8.9	8.5	7	9	8.8-9.0
Final FW temp at capability	485	601	488	471	480	460	472	477	495.4	471	498		488
Demineralizer condensate by-pass												Yes	
Oxy scavenger: (H)ydra, (S)ulf, (M)orpho			SM	S	HM	H	H	H	H	HM		H	
FW htrs group by-passed (H)P, (L)P, (N)ot	N	N	HL	N	HL	L	N	HL	N	N	N	HL	N
Two strings of (H)P, (L)P heaters			H		H	H							HL
Feed pump handles (H)ot, (C)old water	C	H	H	H	H	C	H	H	H	H	H	C	H
Condensing, Cooling Water													
Cooling (T)ower, (I)nduced, (F)orced draft				*							TI		
Cooling tower for supplementary cooling											Yes		
Cooling water (F)resh, (S)alt, (B)rackish	F	F	F	F	F	S	F	B	S	B	F	S	B
Wells for (C)ooling, (D)rinking		D	D	*				C		D	CD		D
Plastic pipe for chem circ		Yes				*				Yes	Yes		
Corrosion protection at (I)ntake, in (C)ondenser, insulated (T)ube sheets		I	C				IC		C	I		C	C
Condenser													
Heaters in throat (No.)		2					2		2	1	2	*	1
Deaeration in (O)pen FW htr, (C)ond	O	O	C	C	O	O	C	O	O	C	O	OC	O
Divided water-box (T)wo-pass (O)ne-pass	O	O	O	T	T	O	O	O	O	O	T	*	T
Cond tubes (Al)um, (Ad)miralty, (C)u-Ni, (S)tainless, (W)elded to tube sheets	Ad	Ad	Ad	Al	Ad	Al-Br	Ad	C	C	C	Ad	Al-Br	Ad
Hot well compartmentized	Yes				Yes		Yes	Yes				Yes	
Reverse flow cleaning	Yes		Yes		Yes	Yes				Yes			
Condenser air removal system, Hogging jet (S)team, (A)ir, (V)acuum pump	S	V	S	V	V	S	V	V	SV	V	V	SV	S
Water velocity, fps	7.5	7	6.2	6.5	T	6.13	6.5	6.5	7.0	7	8	7	4.67
Fans and Pumps													
FD/ID fans per boiler (No. ea)	2/2	2/0	2/2	2/2	2/0	2/0	2/0	2/0	2/2	2/0	2/0	2/0	2/2
Fan couplings (H)ydr, (E)lec, (M)ech	M	M	M	M	M	H	M	H	M	M	M	H	M
Vane control for fans	Yes	Yes		Yes	Yes				Yes	Yes	Yes	Yes	Yes
Feed pumps per boiler (No.)	1	3	2	2	2	2	1	2	2	2	3	2	1
(F)ull, (H)alf size feed pumps	F	1/3	IF, IH	H	H	H	F	H	IF, IH	H	H	IF, IH	F
Feed pump full-load speed, rpm	5620	3575	3600	3470	3600	3600	3500	3550	3600	3570	3600	3215	5550
Feed pump drive (M)otor, (T)urb, (G)ear, Main turbine (S)haft	T	M	IM, IT	M	M	M	S	M	IS, IM	M	M	S	T
Pumps for forced circ (No.), (I)nj seals, (W)et or (H)erm sealed motor drive					3H				1	4I	4I		3H
Standby pumps, No./size	1-half				1-full		1-half		1-full		1-1/3	1-half	1-1/4
Piping and Valves													
Main stm line (F)orgd & bord, (H)ol frgng, (S)eamless, (W)eld seam, (C)entrif-cast	H	H	F	H	S	H	F		H	S	H	F	H
Reht stm line (F)orgd & bord, (H)ol frgng, (S)eamless, (W)eld seam, (C)entrif-cast	HS	W	S	H	S	S	W		H	W	H	W	H
Main stm (F)erritic, (A)ustenitic	F	F	F	F	F	F	F	F	F	F	F	F	F
Reheat stm line (F)erritic, (A)ustenitic	F	F	F	F	F	F	F	F	F	F	F	F	F
Valve betw suprhtr & turb stop omitted	Yes	Yes	Yes	Yes		Yes		Yes			Yes	Yes	Yes
Freeze up averted by (R)outing (E)lec ht	RE	E		E	RE		RE	RE	R	E	E		RE
Insul of Ht pipe (M)ineral, (A)lum shell	M	M	M	MA	MA	MA	M	M	M	MA	M	MA	M
Turbine													
(A)xial-flow, (T)andem, (C)ross-comp	C	T	C	AT	T	T	T	T	C	T	T	C	T
Cross-comp spds (3)600/3600, 3600/(1)800	1		1						1			*	
Side or end outlet exhausts		Bot	End	End	Side				Side	End	Bot	*	End
Flow (O)pposed, (D)ouble, (T)riple, (Q)uad	D	T	OD	T	D	Q	T	T	D	T	T	Q	T
Therm prot when motoring		Yes		Yes		Yes			Yes	Yes	Yes	Yes	
(H)P, (L)P unit shipped assembled													
Length, 3600 rpm last stage blades, in		25		25	29	21	26	23		23	26	*	26
No. of extraction points	6	7	7	7	6	6	7	7	7	6	7	*	7
Generator													
Stator cooling (G)as, (L)iq; (D)ucts, (C)ond	GC	GC	G	G	LC	L	L	L	G	G	GC	G	L
Rotor cooling (G)as; (D)ucts, (C)ond	G	GC	G	G	G	G	G	G	G	G	GC	G	G
Prot for (L)oss of field, (N)eg seq cur	LN	LN	LN	LN		LN	LN	LN	L	LN	LN	LN	LN
Neut grd (R), (X), (D)bn tsf (G)rd flt neut	RD	D	D	D	D	D	D	D	G	RD	D	D	D
Generator shipped assembled	Yes	Yes		Yes	Yes					Yes	Yes	Yes	Yes

27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
E	D	D	D		D	D	D	E	D	D	D	E	D	E		E
1/8.8	1/9.0		50/8.9		1/	2/8.8-9.0	/8.5-9.0	200/10.7	0.1/9.0	1/8.5	1/9	1/8.8	/9	3/9	2/8.0-8.8	15/3.7-9.0
							8.5-9.0	10.7	9.0	8.5	9	8.8-9.0		9	8.8	9.0
8.9-9.0	9.0			481	330		530	464	455	535	450	532	476	499	509	515
488	473	468	509					Yes								
				S	HM		H	H	H	SM	H		H	H	S	M
	SM		HM	N	HL	N		HL		N	N	N	HL	H	N	H
N	H	H	H									HL				
HL			H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	H	H	H													
				Pond	TI								TF		TI	TI
S	F*	F	F	F	F	B	F	F	F	F	F	F	F	S	F	F
D	D	D					CD		D	CD		D			CD	CD
	Yes	Yes		Yes	Yes	*	Yes	Yes							Yes	Yes
C	C											C				I
1	1			1		2						1		1		1
O	O	OC	OC	C	O	C	C	OC	O	C	O	O	O	C	C	O
T	O	O	T	T	T	O	T	T	T	T	T	T	O	O	T	O
C	Ad	Ad	Ad-C		Ad	C	Ad	S	Ad	Ad	Ad	Ad	Al-Br	Al-Br	Ad	Ad
						Yes	Yes									
Yes			Yes				Yes	Yes	Yes					Yes		
S	V	V	V		S	S	V	S	V	V	S	S	S	V	V	S
5.75	7.5	7	6.73		7.75	6.51	7.53	3.8	5.9	7.0	7	7	4.75	6.72	7	8
2/2	2/0	2/0	2/2	2/2	2/0	2/0	2/2	2/2	2/2	2/0	2/0	2/2	2/2	2/2	2/0	2/2
M	M		MH	M	M	M	M	M	E	M	M	M	M	M	M	M
Yes	Yes	Yes	FD only			Yes	Yes	Yes	FD only	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1	2	2	2	2	3	2	3	3	3	2	2	2	2	2	2	3
F	H	H	F	H	H	H	H	H	H	H	H	H	H	H	H	H
5550	3480	3600	3500		3600	3580	3600	3550	3490	3600	3600	3470	3344	3600	3600	3600
T	M	M	*	M	M	M	M	M	M	M	M	M	M	M	M	M
3H			2I						3I			3H	3W	3I		
1-¼					1-half		1-half		1-half							
H	H		H	H	H	H	F	HS	F	H	H	H	F	H	H	H
H	H		S	H	H	H	F	HS	S	H	W	H	H	H	H	H
F	F		F	F	F	F	F	F	F		F	F	F	F	A	F
F	F		F	F	F	F	F	F	F		F	F	F	F	A	F
Yes	Yes			Yes		Yes	Yes	Yes		Yes		Yes				
RE	E	R	R	E	E			R	R	E	E	RE		R	E	E
M	MA	M	M	A	M	A	M	M	M	A	M	M	M	M	MA	MA
T	T	T	C	T	T	T	AT	T	AT	T	T	T	T	T	T	TA
			1													
End	Bot	End		Side		End		End				End	Side	End	Side	End
T	D	D	Single	D	D	D	T	T	OD	D	D	T	T	D	D	OD
	Yes		Yes						Yes		Yes		Yes	Yes		
25	25	29	42	23	24	26	25	23	26	23	23	23	23	26	23	25
7	6	6	7	6	5	6	8	6	7	6	6	7	6	6	6	8
L	G	GL	G	G	G	L	G	GC	G	GC	L	L	G	L	G	LC
G	G	G	G	C	G	G	G	GC	G	GD	D	G	G	G	G	GD
LN	LN	L	L	L	LN	L	LN	LN	LN	LN	LN	LN	LN	L	LN	LN
D	D	X	RD	D	RD	D	D	D	D		R	D	R	D	RD	RD
Yes				Yes	Yes				Yes	Yes		Yes		Yes		

2—Turbine, Generator and Mechanical Equipment

Plant Number	44	45	46	47	48	49	50	51	52	53	54	55	56
Heat Cycle Apparatus													
Makeup (E)vap, (D)emin	D	D	D	E	D	D	D	D	E	D	D	D	D
FW solids held to.....ppm; pH	4/7	1.0/8.0	/7.5-8			0/9	0.5/8-10			1/9.0	0.25/9	50/10.5	/8.5-9
Economizer pH at	7.0	8.0	7.5-8			7.5	8-10			9.0	9	9.0	9.0
Final FW temp at capability	459	502	460	450	460	308	453	515	480	507	468	460	458
Demineralizer condensate by-pass		Yes			Yes							Yes	
Oxy scavenger: (H)ydra, (S)ulf, (M)orpho	H			S	HMS	S	HSM	H	SM	HS	S	S	S
FW htrs group by-passed (H)P, (L)P, (N)ot	N	HL	HL	HL	HL	H	H	N	H	N	N	N	H
Two strings of (H)P, (L)P heaters				L									
Feed pump handles (H)ot, (C)old water	H	H		H	H	H	H	H	H	C	H	H	H
Condensing, Cooling Water													
Cooling (T)ower, (I)nduced, (F)orced draft		TI	TI								Pond		Pond
Cooling tower for supplementary cooling		Yes											
Cooling water (F)resh, (S)alt, (B)rackish	F	F	F	S	BS	F	F	F	F	S	F	F	F
Wells for (C)ooling, (D)rinking					D	CD	D		D		CD		
Plastic pipe for chem circ		Yes		*					C	IC	Yes		
Corrosion protection at (I)ntake, in (C)ondenser, insulated (T)ube sheets		C	C	IT	T	C							
Condenser													
Heaters in throat (No.)		2	2	2	2					2	1	1	
Deaeration in (O)pen FW htr, (C)ond	O	OC	O	O	O	O	OC	O	O	O	C	O	O
Divided water-box (T)wo-pass (O)ne-pass	T	O	T	T	T	T	T	T	O	O	T	T	T
Cond tubes (Al)um, (Ad)miralty, (C)u-Ni, (S)tainless, (W)elded to tube sheets	Ad	Al	Ad	Al-Br	Al-Br	Al	Ad	Al	Ad	C	*	Ad	Ad
Hot well compartmentized	Yes	Yes			Yes								
Reverse flow cleaning	Yes	Yes			Yes								
Condenser air removal system, Hogging jet (S)team, (A)ir, (V)acuum pump	SV	AV	S	S	S	S	S	V	V	S	S	S	V
Water velocity, fps	7.0	6.5	7.5	6.23	6.7	7.41	10	*		5.87	8	6.99	7.48
Fans and Pumps													
FD/ID fans per boiler (No. ea)	2/2	2/0	2/2	2/0	2/0	2/0	2/2	2/2	2/0	2/2	2/2	2/0	2/0
Fan couplings (H)ydr, (E)lec, (M)ech	H	M	M	H	M	H	HM	F	M	H	M	M	M
Vane control for fans	FD only	Yes	Yes		Yes		FD only		Yes		Yes	Yes	Yes
Feed pumps per boiler (No.)	3	3	2	2	2	2	2	2	2	2.5	2	2	2
(F)ull, (H)alf size feed pumps	H	H	H	60%	60%	H	60%	H	H	H	H	H	H
Feed pump full-load speed, rpm	3510	3580	3600	3490	3600	3560	3480	6300	3570	3450	3450	3562	3570
Feed pump drive (M)otor, (T)urb, (G)ear, Main turbine (S)haft	M	M	M	M	M	M	M	M	M	M	M	M	M
Pumps for forced circ (No.), (I)nj seals, (W)et or (H)erm sealed motor drive								3					
Standby pumps, No./size	1-half									1-half			
Piping and Valves													
Main stm line (F)orgd & bord, (H)ol frgng, (S)eamless, (W)eld seam, (C)entrif-cast	H	H		H	S	H	S	H		HS	H	S	S
Reht stm line (F)orgd & bord, (H)ol frgng, (S)eamless, (W)eld seam, (C)entrif-cast	H	H	S	H	S	H	W	W		HS	H	S	S
Main stm (F)erritic, (A)ustenitic	F	F	F	F	Alloy	F	F	A		F	F	F	F
Reheat stm line (F)erritic, (A)ustenitic	F	F	F	F	Alloy	F	F	A		F	F	F	F
Valve betw suprhtr & turb stop omitted				Yes		Yes			Yes	Yes	Yes	Yes	Yes
Freeze up averted by (R)outing (E)lec ht	E	E	RE		RE	E	R		E		E	E	RE
Insul of Ht pipe (M)ineral, (A)lum shell	M	M		M	M	M	A	M			A	MA	M
Turbine													
(A)xial-flow, (T)andem, (C)ross-comp	T	T	AT	AT	T	T	T	T	T	T	T	T	T
Cross-comp spds (3)600/3600, 3600/(1)800													
Side or end outlet exhausts		End	End	Bot	End	Bot			Bot		Side		
Flow (O)pposed, (D)ouble, (T)riple, (Q)uad	D	D	OD	D	D	D	D	D	D	OD	D	D	D
Therm prot when motoring	Manual			Yes		Yes	Yes		Yes		Yes	Yes	Yes
(H)P, (L)P unit shipped assembled													
Length, 3600 rpm last stage blades, in.	26	26	23	26	26	25	26	26	26	23	23	23	23
No. of extraction points	7	7	7	7	6	5	6	7	6	6	5	5	5
Generator													
Stator cooling (G)as, (L)iq; (D)ucts, (C)ond	D	LC	G	G	G	G	G	G	L	G	G	G	GC
Rotor cooling (G)as; (D)ucts, (C)ond	C	G	G	G	G	G	G	G	GC	G	G	G	GC
Prot for (L)oss of field, (N)eg seq cur	LN	LN	LN	LN	LN	LN	LN	LN	LN	LN	L	LN	LN
Neut grd (R), (X), (D)bn tsf (G)rd flt neut	D	D	D	D	R	D	RD	R	D	D	D	D	D
Generator shipped assembled		Yes				Yes	Yes			Yes	Yes	Yes	Yes

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
D	ED	D	E	D	D	D	D	E	D	E	E	D	E	D	E	D
5-10/7-8		3/8.5	4.0/9.0			/8.9-9.1	75/10.5	/8.4		2/8.5	40/8.8-9.2			150/	/8	0/7.8
8.6		8.5	9.0	8.8		8.9-9.1	8.0			8.5	8.8-9.2				8	
460	464	472	460	500	449	466	525	454	419	430	435	460	410	415	435	350
														Yes		
S	S	HS	SM	H	S	S	HS	S	S	HS	S	H		S	H	H
N	HL	HL	N	N	N	N	N	N	H	H	HL	HL	N	N	N	HL
		HL					HL							L		
H	H	H	H	C	H	H	H	H	H	H	H	H	H	H	H	C
I								Lake		TI	TI		TI			TI
F	F	F	F	B	F	B	F	F	B	F	Sew Eff		F	F	F	F
CD	D	D	D	D		D	CD			CD	D	D		D	D	CD
PVC				Yes				Yes		Yes				Yes	Yes	Yes
				ICT					C	IC	I					I
	1	2	1	1					1	1	1	1	1	1		
OC	O	O	OC	C	O	OC		O	O	O	O	O	O	C	C	O
T	T	T	T	O	T	T	T	T	T	T	T	T	T	T	T	T
Ad	Ad	Al	Ad	C	Ad	Al-Br*	Ad	Ad	C		Ad	Ad	Ad	Ad	Ad	Ad
	Yes			Yes		Yes			Yes		Yes			Yes		
	Yes			Yes	Fut	Yes								Yes	Yes	
S	S	S	S	S	V	V	S	SV	V	S	S	S	S	S	S	S
7.5		7	6	7	7.5	7		7	6.5	7.35	7	7.0	7.07	7	7.5	6
2/0	2/2	2/0	2/2	2/0	1/0	1/1	2/2	1/0	1/1	1/0	1/0	1/1	1/1	1/1	1/0	1/1
M	M	M	H	E	H	HM	H	M	M	M	M	M	M	H	M	M
Yes	Yes	Yes		Yes		FD only	Yes	Yes	FD only	Yes	Yes	Yes	FD only	Yes	Yes	Yes
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
60%	F	H	2/3	F	70%	F	F	H	H	F	F	F	F	60%	F	H
3750	3600	3600	3480	3470	3600	3470	3465	3600		3460	3600	3600	3600	3600	3550	3600
M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	MT
			1-2/3													
H	S	HS	H		S	S	H	H	S	S	H	S	S	F	S	S
H	S	HS	W		S	S	H	H				S				
F	F	F		F	A	F	A	F	F	F	F	F		F	F	F
F	F	F		F	A	F	A	F				F				
		Yes				Yes	Yes					Yes				
E	E	RE	R	R	R		R	RE		E	R	R		E	RE	
A	M	M	M	MA	M	MA	M	M	M	MA	M	M		M	MA	MA
T	T	T	T	T	T	T	T	T	T	T	AT	T	T	T	A	A
	Side	Side	Side	Side				End		End				End		
D	D	D	D	D	D	D	D	D	D	D	D	D	D		D	
Alarm		Yes		Yes		Yes				Yes	Yes				Yes	
														H		HL
23	23	25	23	20	20	20	23	20	20	20	20	18	18		18	
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	4
G	G	G	G	G	G	GD	G	G	G	G	G	G	G	G	G	G
G	G	G	G	G	G	GD	G	G	G	G	GD	G	G	G	G	G
LN	LN	LN	L		LN		LN	LN	LN	N	LN		LN	L	LN	
D	X	D	D	D	D	D	D	D	R	D	RD	D	D	D	D	X
Yes		Yes	Yes	Yes					Yes		Yes			Yes	Yes	Yes

3—Electrical Auxiliaries and Control

Plant Number	1	2	3	4	5	6	7	8	9	10	11	12	13
Exciter													
Main exc (Sh)aft driven, (M)g, (S)tatic..	Sh	M	Sh	S	Sh	M	M	M	Sh	M	M	M	M
Pilot exc (D)ir conn (M)g set (R)otat amp	R	RM	R	R	R	R	R	Mag Amp		R	Stat amp	M	
Spare exc (M)otor driv, (N)one	N	M		N	N	N	M	N	M	M	N	N	N
Sets transferred under load		Yes							Yes	Yes			
Regul'n prot against loss of poten'l srce	Yes		Yes	Yes	Yes	Yes	Yes	Yes		Yes		Yes	
Generator grd fault (T)rip (A)larm.....	T	T	T	T	T	T	T	T	T	T	TA	TA	TA
Station Auxiliary Power													
Aux system (U)ngrounded; (G)rounded directly, (R)esistance grounded	R	R	R	R	R	G	G	R	G	R	R	R	U
Aux system voltage (2)400, (4)160.....	6900	4	4	4	4	4	4	4	4	4	4	4	4
Aux Tsfm;.....No. per generator.....ph, ...mva (O)il, (A)sk, (D)ry, (N)it	1, 3 18/24	1, 3 12.5	1, 3 10/12.5	1, 3 12/16	1, 3 10/12.5	1, 3 25	1, 3 15/20/25	2, 3 18	2, 3 11.5	2, 3 12/16	2, 3 11/13.75	3, 3 7.5/9.37	1, 3 15
(S)elf, (EO), (FA), (FOA)	S, FA	FA	O	S, FA	O, S, FA	SF_6	O, S, FA	O, FA	O, S	FOA	OA, FA	O, S, FA	S
Largest motor on LV bus, on HV bus, HP	5000	250 3000	1750	3500	2000	2000 6000	2000 6000	250 5000	400 5000	4000	200 5000	370 4500	300 3500
Total nameplate motor load, oper cond..		30000				12000	12000	17000	24800	28000	28000	24000	
Automatic transf to aux source (I)nst, (D)elayed (time in sec)	D-1	I	D-1	D-1	D-1	D-3	D-3	ID	D-60		I	I	D-5-6
Pow cble in (D)uct, (T)ray, (P)ipe, (R)ack	T	DTP	T	TP	T	D	D	DTPR	D	T	T	PT	DT
(F)iber, P)lastic, (A)sh-cem, (S)teel (Al)um conduit	Al	AS	Al		Al	Al Duct	Al Duct	Al AS	F	S	AS	S	F
No. of generator units served per battery	1	1	1	1	1	½	½	1	1	1	1⅓	1	1
Control Instrumentation													
Contr centr serves (1), (2), (3), (4), units	2	4	2	2	2	2	2	1	1	2	4	8	2
Cont cbls in (D)uct, (P)ipe, (R)ack, (T)ray	TP	DTP	T		T	DT	DT	DPT	DP	PT	TD	T	T
Contr & (H)v, (L)v, pow cble in same tray		L							L	L	L	L	
Ext Comm (T)elep, (C)arrier, (M)icrowave	TCM	T	TCM	TCM	TCM	T	T	TC	TM		C	TM	TM
Internal comm (P)ub add, Priv (T)el.....	PT	PT	PT	PT	PT	T	T	P	PT	PT	P	PT	PT
Data-loggers	Yes		Yes	Yes	Yes			Yes					Yes
Heat rate performance computers.....								Yes					Yes
Bus and Cable													
Gen leads (C)able, (B)us	B	B	B	B	B	B	B	B	B	CB	B	B	B
Gen leads (C)opper, (A)lum, (W)elded....	AW	A	A	AW	AW	C	C	AW	C	CAW	A	A	AW
Gen leads (I)sol-ph, (S)egr-ph (F)ield fabricated, Sel(f), (FA)cooled	SF FA	I f	S FA	SF FA	SF FA	I f	I f	I	I f	S f	I f	IF	
Substa bus (S)train, (R)ig, (A)lum, (W)eld	RAW	RA	RAW	RAW	RAW	RAW	RAW	RAW	S	RA	RAW	A	SA
Power cable insulation; (O)il base rubber, (B)utyl rubber, (P)olyeth, P(V)C	P	B	P	P	P	Paper	Paper	O	O	BV	B	B	O
Powr cble sheath; (N)eopr, (L)ead, (P)oly, P(V)C, (A)rmored, (S)teel, (Al)um.....	V	V	V	V	V	L	L	N	N	NL	V	V	A, Al
Control cble insul; (O)il bas rub, (B)utyl rub, (P)olyeth, P(V)C, (L)ow moist rub	P	B	P	P	P	V	V	L	O	V	B	B	OB
Control cable sheath; (N)eoprene, (P)oly-eth, P(V)C, (A)rmored, (S)teel, (Al)um	V	V	V	V	V	*	*	N	N	N	V	N	N
Outgoing Substation													
Tsfm rating;.....ph,....Mva	3-375	3-600	3-315	3-315	3-315	*	*	3-400	3-370	3-383	3-360	3-365	3-360
Cooling (S)elf, (FO), (FA), (FOA), (FOW)	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOW	FOA
Fire prot (W)ater, (C)O_2, (M)uls (D)ry...	W	W	W	W	W	M	M	M	W	W	C	W	WC
Structure (P)ipe, (A)ngles, (C)hannels C(o)ncrete, (Al)uminum	A	o	A	A	A	AC	PAC	Al	A	AC	AC	A	C
Pressure relays, (A)larm, (T)rip	T	AT	T	T	T	A	A	A	T	A	T	T	A
Ltng prot (M)asts, (G)rd mesh	G		G	G	G	M		G	M				G
Ltg arr on (T)sfmtern, (O)mitted	T	T	T	T	T	T	T	T	T	T	T	T	T
Lighting													
Contr room, (C)ove ltg (L)um ceiling....	L	L	CL	L	L	L	L	L	L	L	L	L	L
Genl sta ltg (I)ncan, (F)luor, (M)ercury..	IFM	IFM	IFM	IFM	IFM	F	F	IFM	I	F	FM	FM	I
Lighting volt (120/208), (120/240), (277/480)	120/240	120/240 277/480	120/240	120/240	120/240	120/208	120/208	127/220	120/208	277/480	120/208 277/480	277/480	120/208 120/240

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
M	Sh	M	Sh	Sh	Sh	M	Sh	Sh	M	Sh	M	M	M	Sh	Sh	Sh
		Stat amp	M	R	D		R	R				MR	MR		R	
M	M	M	N	N	N	N		M	M*	M	N	N	N	N	M	M
Yes	Yes									Yes		Yes	Yes		Yes	Yes
Yes	Yes		Yes				Yes		Yes	Yes		Yes	Yes			
T	TA	T	T		T	T	T	A	T	TA	TA	T	T	T	T	T
R	U	R	R		R	R	R	U	G	U	U	R	R	R		R
4	2	4	4	4	4	4	4	4	4	4	4	2	2	4	4	4
2, 3	2, 3	2, 3	1, 3		1, 3	1, 3	1, 3		1, 3	1, 3	1, 3	1, 3	1, 3	1, 3	1, 3	2, 3
16	7.5	10	20		10/12.5	12/16	12.5		12/16	16	7.5/9.4			10	20	
O, S, FA	O, FA	O, S	O,FA,FOA		O, FA	O,N,S,FA	O, FA	O, FA	A, FA	O, FA	S, FA	O, FA	O, FA	O, S	O, FOA	OA/FA
125	350	200	250		200	200	200		200	250	300	150	150	150	200	200
5000	3500	4000	3000	5000	3000	3000	4000	4000	3000	3500	1500	1750	1750	2250	3000	1000
18000	12240	13850	15000		24500	11350		11500		15700		9880	9880	8270		12600
Phase angle		I	I	I	D	I			I		D	D	D	I		I
T	D	DP	T	TR	T	DTP	TP	T	T	D	DT	T	T	DT	T	T
S	FS	F	S		S	A	FS	AI	AI	FS	F	FS	FS	AS	S	S
1	1	1	3	2	1	1	2	2	2	2	2	2	2	4	1	1
2	1	4	3	2	2	5	4	1	2	2	2			4	1	2
T	DPR	R	T	TR	T	DPT	PT	T	T	DPRT	T	T	T	DT	TP	T
	L		L	HL	HL	L	H		L	L					HL	
TM	TC	T	TCM	TC	TCM	TM	TM	TM	TCM	TC	TCM	CM	CM	T	TM	TM
P	T	PT	PT	T	PT	P	P	P	PT	T	PT	PT	PT	P	PT	T
				Yes				Yes	Yes		Yes				Yes	
				Yes	Yes	*		Yes	Yes*		Yes*					
B	B	B	B	B	B	B	B	B	B	B	B	B	B		B	B
AW	AW	A	AW	C	A	AW	A	A	A	AW	AW	A	A		C	AW
I	S	I	I		IS	S	I	I	I	SF	I	I	I		IF	I
f			f								f	f	f			f
S	AW	RA	S		S	RAW	RAW	SW	A	RA	SA	S	S	RAW		SA
O	O	O	B		V	B	B	B	OBPV	O	O	V	V	B	V	O
N	N	N	N		V	N	NAS	N, AI	NVA	N	A, AI	N	N	N	N	N
O	L	O	P		V	P	P	PV	OBPV	L	OB	V	V	P	V	P
N	N	N	V		V	V	N	V	NVA	N	N	V	V	V	N	V
3-420	3-180	3-315	3-87	3-315	3-270	3-270	3-300	3-275	3-265	3-90	1-182	3-265	3-265	3-200	3-224	3-217
FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA
W	WM	W	W	W	W	W	W		W	WM	WC	W	W	W	W	M
A	A	AC	A	A	C	AC	A	A	A	A	C	AC	AC	AC	AC	A
	A	A	A		AT	T	A		A	A	A	T	T	T	T	T
G		MG	M	MG	G	G	G	G	MG		G	MG	MG	MG	M	M
T	T	T			T	T	T	T	T	T	O	T	T	T	T	O
L	L	L	L	L	L		L	CL	L	L	L	L	L	L	L	L
IFM	IFM	IM	F		FM	I	IFM	FM	IM	IFM	I	IM	IM	I	IFM	IM
120/208	120/208	120/240	120	120/208	277/480	120/208	120/208	277/480	120/240	120/208	120/208 120/240	120/240	120/240	120/208 120/240	120/277	120/240 480

3—Electrical Auxiliaries and Control

Plant Number	31	32	33	34	35	36	37	38	39	40	41	42	43
Exciter													
Main exc (Sh)aft driven, (M)g, (S)tatic..	Sh	M	M	Sh	M	M	Sh	Sh	M	M	Sh	Sh	Sh
Pilot exc (D)ir conn (M)g set (R)otat amp	D	M	R	R	Mag Amp	MR		R	MR	M	M		R
Spare exc (M)otor driv, (N)one	N	N	M	N	M	M	M	N	N	M	M	N	N
Sets transferred under load			Yes		Yes	Yes	Yes		Yes		Yes		
Regul'n prot against loss of poten'l srce	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Generator grd fault (T)rip (A)larm.....	T	A	T	TA	TA	T	TA	T	T	T	TA	TA	TA
Station Auxiliary Power													
Aux system (U)ngrounded; (G)rounded directly, (R)esistance grounded	U	G	U	U	U	R		R	R	U	U	U	R
Aux system voltage (2)400, (4)160.....	4	4	4	4	2	4	4	4	4	4	4	4	4
Aux Tsfm;.....No. per generator.....ph, ...mva (O)il, (A)sk, (D)ry, (N)it	0	1-3 12.5	1-3 12/16	1-3 6.25	2-3 8	2-3 12/16	2-3		1-3 12.5	1-3 11/13.75	1-3 12.5	1-3 12.5	1-3 12/16
(S)elf, (EO), (FA), (FOA)	S	O,S,FA	O, FA	O, FA	O, S	FA	O, FA	O, FA	O, FA	A, FA	O, FA	A, FA	O, S, FA
Largest motor on LV bus, on HV bus, HP		3000	150 3000	3500	100 2500	150 2750	125 2250	2500	125 3000	240 2000	300 3000	75 2250	150 2250
Total nameplate motor load, oper cond..			15134		15000	13800	10000		15240	11000	16000	13190	13665
Automatic transf to aux source (I)nst, (D)elayed (time in sec)	D	I	D-1	I	I	I	I	D	D	D		I	I
Pow cble in (D)uct, (T)ray, (P)ipe, (R)ack	D	T	T	R	P	T	DTP	T	T	D	D	T	DTP
(F)iber, P)lastic, (A)sh-cem, (S)teel (Al)um conduit	A	Al	S		S	Al	FS	S	FS	F	S	S	FSA
No. of generator units served per battery	2	2	2	2	4	8		1	2	2	2	1	2
Control Instrumentation													
Contr centr serves (1), (2), (3), (4), units	1	4	2	2	4	2	1	2			2	1	2
Cont cbls in (D)uct, (P)ipe, (R)ack, (T)ray	DT	T	T	T	T	T	DPT	T	T	DPT	T	T	DPT
Contr & (H)v, (L)v, pow cble in same tray		L				HL	L	HL			HL	HL	L
Ext Comm (T)elep, (C)arrier, (M)icrowave	TM	TCM	T	TC	TM	TC	TM	TC	CM	T	TCM	TM	TC
Internal comm (P)ub add, Priv (T)el.....	PT	P	PT	PT	PT	PT	PT	T	PT	T	PT	P	PT
Data-loggers		Yes					Yes			Yes		Yes	
Heat rate performance computers.....		Yes					Yes	Yes		Yes		Yes	
Bus and Cable													
Gen leads (C)able, (B)us	B	B	B	B	B	B	B	B	B	CB	B	B	B
Gen leads (C)opper, (A)lum, (W)elded....	AW	C	AW	C	C	AW	AW	A	A	C	A	A	AW
Gen leads (I)sol-ph, (S)egr-ph (F)ield fabricated, Sel(f), (FA)cooled	F	I f	I f	I	IF	IS	IF f	I	I f	I	I	I	IS
Substa bus (S)train, (R)ig, (A)lum, (W)eld	S	RAW	S	SAW	S	RAW	AW	RA	S	R	R	A	AW
Power cable insulation; (O)il base rubber, (B)utyl rubber, (P)olyeth, P(V)C	B	B	B	B	O	O	P	B	V	O	OB	B	VOP
Powr cble sheath; (N)eopr, (L)ead, (P)oly, P(V)C, (A)rmored, (S)teel, (Al)um.....	N	N	A, Al	N	N	N	NPA	N	N	N	N	N	NV
Control cble insul; (O)il bas rub, (B)utyl rub, (P)olyeth, P(V)C, (L)ow moist rub	V	B	P	P	O	B	PL	B	V	O	OB	P	LVP
Control cable sheath; (N)eoprene, (P)oly-eth, P(V)C, (A)rmored, (S)teel, (Al)um	N	N	V	V	V	N	NPA	N	V	N	N	N	V
Outgoing Substation													
Tsfm rating;....ph,....Mva	3-200	3-200	3-180	3-205	3-195	1-180	3-200	3-195	3-210	3-180	3-190	3-180	3-180
Cooling (S)elf, (FO), (FA), (FOA), (FOW)	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA
Fire prot (W)ater, (C)O_2, (M)uls (D)ry...		D	W	W	W	M	W	W		W	W	M	W
Structure (P)ipe, (A)ngles, (C)hannels C(o)ncrete, (Al)uminum	A	A	AC	AC	AC	AC	P	A	AC	AC, Al	ACo	C	A
Pressure relays, (A)larm, (T)rip	T		AT	A	AT	T	A	T	T	A	A	A	T
Ltng prot (M)asts, (G)rd mesh	G	G	M	M	O.H.Wire	MG	G	G	MG	M	M	M	MG
Ltg arr on (T)sfmtern, (O)mitted	T	T	T	T	T	T	T	T	T	T	T	T	T
Lighting													
Contr room, (C)ove ltg (L)um ceiling....		L	L	L	L	L	L	L	L		C	L	L
Genl sta ltg (I)ncan, (F)luor, (M)ercury..		F	I	F	I	IFM	IF	IFM	IM	I	IF	I	IFM
Lighting volt (120/208), (120/240), (277/480)		120/208	120/240	120/240	120/208	120/240	120/240 /480	277/480	120/240	120/240	120/208	120/240	120/208

44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
M	Sh	Sh	Sh	Sh	Sh	Sh	M	Sh	M	Sh	Sh	S	Sh	Sh	Sh	S
R		D	R	M	D	R		R		D	D	R	M		R	Mag Amp
M		N	M	N	N	M	M	N	M	N	M	N	M	N	N	M
Yes						Yes			Yes		Yes					
		Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
T	AT	TA	T	A	TA	T	A	TA	A	T	A	T	T	T	TA	TA
R	R	R	R	R	U	U	R	R	G	U	U	U	U	R	R	U
4	4	4	4	2	4	2	4	4	4	4	2	2	4	2	4	2
	1-3		1-3	1-3	1-3	2-3	1-3	1-3	1-3	1-3	2-3	1-3	1-3	2-3	2-3	1-3
	12.5		7.5	9.375	12/16	5	10/12.5	10	10	10	7.5	6.25	6.5	10	8/10	6.67
OA, FA	O, FA	O, FA	O, FA	O, S, FA	S, FA	OA	O, FA	O	FA	O, S	O, S	O, FA	O	OA/FA	OA/FA	D
200	150	250	250		200	125		125	200	100	50	75	75	125	300	150
2250	3000	2500	2500	2000	2250	1500	2500	2500	2000	1750	1250	1250	1500	2200	2000	1250
18500	15730	11644	11350	6000	14000	9627	13400	10000			5310	5285	6875	8350		6647
I	I	I	D-1.5	D	I	I		I	I	D	I	I	D-1	I	D	I
T	DTPR	P	DR	DTP	DT	DTR	T	D	DTP	D	TP	DP	DT	TP	DT	TP
S	FSA	S	S	FS	AI	A, AI	S, AI	F	AI	A	AI	FS	A, AI	SF	PS, AI	S
4	2	1	2	1	2	2.5	3	1	2	1	2	2	2	2	1	2
4	2	1	2	1	3	1	4	1	2	1	1	2	3	2	1	5
T	PT	T	T	DT	PT	DRT	RT	DPT	T	DT	PT	DP	T	TP	DT	TP
HL					L	HL	L	L			HL		L	HL	HL	L
M	T	M	TM	TC	TC	C	TM	TC	TM	TM	TM	TM	TCM	TCM	TC	C
PT	P	PT	PT	PT	PT	PT	PT	P	PT	PT	PT	P	T	P	PT	PT
		Yes					Yes			Yes						
		Yes					Yes			Yes						
B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
AW	C	A	AW	A	A	A	AW	AW	AW	AW	A	C	A	A	AW	C
I	I	I	IF	I	I	I	I	SF	I	F	I	I	I	IS	T	I
	f		f		f	f		f	f		f					
S	SR	SA	R	RA	RAW	R	RAW	RAW	R	S	AW	S	S	RA	RAW	RA
B	Kerite		B	O	B	O	O	O	B	B	O	BP	O	B	B	B
N	PAS		V	N	V	NV	A, AI	N	N	N	N	NV	N	N	ASV, AI	N
B	P		P	P	B	OP	O	P	PV	V	P	P	P	P	P	B
N	V		V	V	NV	NVAS	N	V	N	N	V	V	V	V	V	N
3-175	3-200	3-182	3-150	3-75	3-180	3-145	3-160	3-200	3-75		3-140	3-130	3-130	3-120	3-125	3-90
FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOW	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA
W	W	W	W	WD		W	W		W		W	W	W	W	W	
A	AE		AC	AC	AC	oC		A	P	A	AC	A	H-beam	CA	AC	AL
	T	AT	T	A	A	A	A	A		T	AT	T	T	A	T	A
G	MG	MG	G	MG	M	G	MG	G	M	G	M	MG		G	G	G
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	L		L	C	L	C	L	L	L		L	L	L	L	L	
IM	I		FM	IFM	I	FM	F	IFM	F		IM	I	I	FI	FI	FI
120/208	120/208			277/480	120/208	277/480	277/480	120/208	277/480		120/208	120/208	120/208	120/240	120/240	120/208

3—Electrical Auxiliaries and Control

Plant Number	61	62	63	64	65	66	67	68	69	70	71	72	73
Exciter													
Main exc (Sh)aft driven, (M)g, (S)tatic..	Sh	Sh	S	Sh	Sh	M	Sh	S	M	S	Sh	Sh	Sh
Pilot exc (D)ir conn (M)g set (R)otat amp	M	R	R	D	D	M	R	M	M		D	DR	Stat Amp
Spare exc (M)otor driv, (N)one	M	M	N	M	N	M	N	N	N	N	N	N	M
Sets transferred under load	Yes			Yes		Yes							Yes
Regul'n prot against loss of poten'l srce	Yes		Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes	
Generator grd fault (T)rip (A)larm.....	A	T	T	T	T	T	AT	A	T	A	TA	A	T
Station Auxiliary Power													
Aux system (U)ngrounded; (G)rounded directly, (R)esistance grounded	G	U	G	U		U	R	G	U	G	U	U	G
Aux system voltage (2)400, (4)160.....	4	2	2	2	2	2	2	2	2	2	2	2	4
Aux Tsfm;.....No. per generator.....ph, ...mva (O)il, (A)sk, (D)ry, (N)it	1-3 7.5	1-3 5	1-3 6	1-3 7.5	1-3 7.5	1-3 5	1-3 5	1-3 3.75	1-3 3.75		2-3 5	1-3 3.75	1-3 2
(S)elf, (EO), (FA), (FOA)	FA	D	DS	OS	OS	AS	OS	ONS	OA	OS	AS	A	D
Largest motor on LV bus, on HV bus, HP	125 1750		75 2250	150 2000	100 1000	100 1250	75 1500	125 1000	1250	350 1000	700	1500	250
Total nameplate motor load, oper cond..	4000		6500		3500	5000	4000	3500		6000	3954	4000	
Automatic transf to aux source (I)nst, (D)elayed (time in sec)	I	I		D-25	I	D	D-6	D	D	I	I	D-5	I
Pow cble in (D)uct, (T)ray, (P)ipe, (R)ack (F)iber, P)lastic, (A)sh-cem, (S)teel	T	T	DT	T	DT	DT	T	DT	PR		P	P	P
(Al)um conduit	FPS, Al	S	S		FS	FS	S	AS, Al	A		F, Al	AS	S
No. of generator units served per battery	1	1	2	2	1	3	1	1	1	1	3	2	1
Control Instrumentation													
Contr centr serves (1), (2), (3), (4), units	1	1	5	2	1	3	4*	3	3	2	2	4	
Cont cbls in (D)uct, (P)ipe, (R)ack, (T)ray	T	T	T	T	R	T	T	PT	PT	DT	T	T	D
Contr & (H)v, (L)v, pow cble in same tray	HL	HL	L		HL	L	HL		L	L	L		
Ext Comm (T)elep, (C)arrier, (M)icrowave	TM		TC	T	T	T	M	T	T	TC	TM	T	
Internal comm (P)ub add, Priv (T)el.....	PT	P	P	T	PT	P	PT	P	T	T	PT	P	P
Data-loggers		*			Yes						Yes		
Heat rate performance computers.....							Yes						
Bus and Cable													
Gen leads (C)able, (B)us	B	B	B	C	B	B	B	B	B	B	B	B	B
Gen leads (C)opper, (A)lum, (W)elded....	C	AW	C	C	A	A	C	C	C		C	AW	C
Gen leads (I)sol-ph, (S)egr-ph (F)ield fabricated, Sel(f), (FA)cooled	I	I	S f	SF f	IF	I	I	IF	I		I f	I	T
Substa bus (S)train, (R)ig, (A)lum, (W)eld	SR		S	S	R	S	RA	S	R	A	RA	SR	
Power cable insulation; (O)il base rubber, (B)utyl rubber, (P)olyeth, P(V)C	B	B	O	O	P	B	P	O	BO		P	OB	O
Powr cble sheath; (N)eopr, (L)ead, (P)oly, P(V)C, (A)rmored, (S)teel, (Al)um.....	NVA	N	N	N	NL	N	N	N	VA		N	N	N
Control cble insul; (O)il bas rub, (B)utyl rub, (P)olyeth, P(V)C, (L)ow moist rub	B	B	O	O	P	P	P	O	O		P	PN	O
Control cable sheath; (N)eoprene, (P)oly-eth, P(V)C, (A)rmored, (S)teel, (Al)um	N	N	N	N	N	V	N	N	V		N	V	N
Outgoing Substation													
Tsfm rating;....ph,....Mva	3-110	3-85	3-105	3-96	3-90	3-75	3-85	3-85	3-60	3-50	3-42	3-59	
Cooling (S)elf, (FO), (FA), (FOA), (FOW)	FO, FA	FOA	FOA	FOA	FOA	FOA	FOA	FOA	FOA		FA	FA	
Fire prot (W)ater, (C)O_2, (M)uls (D)ry...	W		W		C	W		D	M		W		
Structure (P)ipe, (A)ngles, (C)hannels C(o)ncrete, (A)luminum	C		AC	AC	A	A	AC, Al	C	A	A	A	A	
Pressure relays, (A)larm, (T)rip	A	A	A			T	AT	A	A		AT	T	
Ltng prot (M)asts, (G)rd mesh	M		MG	MG	M	M	MG	M	M	M	MG	M	
Ltg arr on (T)sfmtern, (D)mitted	T		T	T	T	T	T	T		T	T	T	
Lighting													
Contr room, (C)ove ltg (L)um ceiling....	L		L	L	L	L	C				L	L	L
Genl sta ltg (I)ncan, (F)luor, (M)ercury..	IFM	I	FM	I	F	I	IF	I	I	IFM	IM	IFM	I
Lighting volt (120/208), (120/240), (277/480)	120/208 277/480	120/240	120/208	120/240	277/480	120/240	120/208	120/208	120/240	120/208	120/208		120/240

With General Electric Network Transformers

High vault temperature or heavy loads no threat

Permalex* transformers permit continuous operation at 100% of rating in 50 C vaults or 112% of rating in 40 C vaults

The new 55° @ 65° Permalex transformer insulation system provided in General Electric network units assures maximum reliability, regardless of today's heavy loads or high vault ambient temperatures.

A 12-percent increase over standard kva continuous loading may be obtained in a standard 40 C maximum vault ambient with the 65 C rating. Or the transformer may be operated continuously at the standard 55 C rating in a 50 C maximum vault ambient. In either case, the maximum hottest spot temperature would not exceed 115 C which, with Permalex transformers, permits continuous operation at rated kva *without loss of normal life expectancy.*

Always specify "Permalex network transformers" to get this added reliability and built-in money-saving loading capability.

Ask your General Electric Sales Engineer for more information about Permalex transformers as well as other outstanding G-E network transformer features. Or write to Section 484–02, General Electric Co., Schenectady, N. Y.

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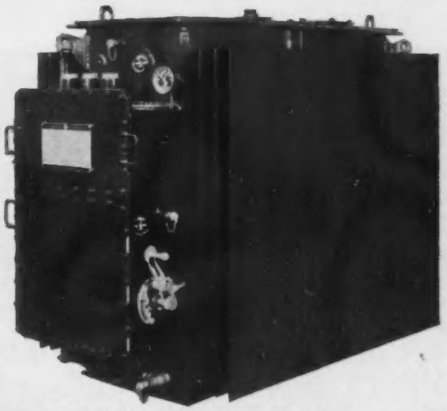
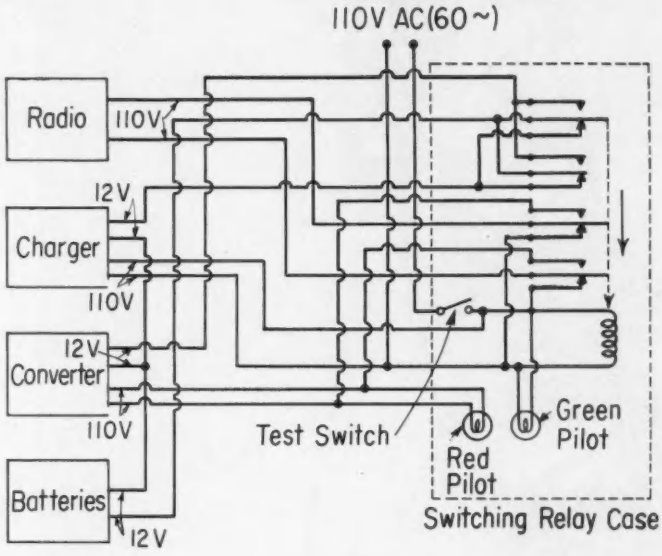


General Electric Permalex network transformers may be operated at 112 percent of rated load in a maximum vault ambient temperature of 40 C, or they may be operated at 100 percent of rated kva in higher temperatures (up to 50 C maximum vault ambient).

Progress Is Our Most Important Product

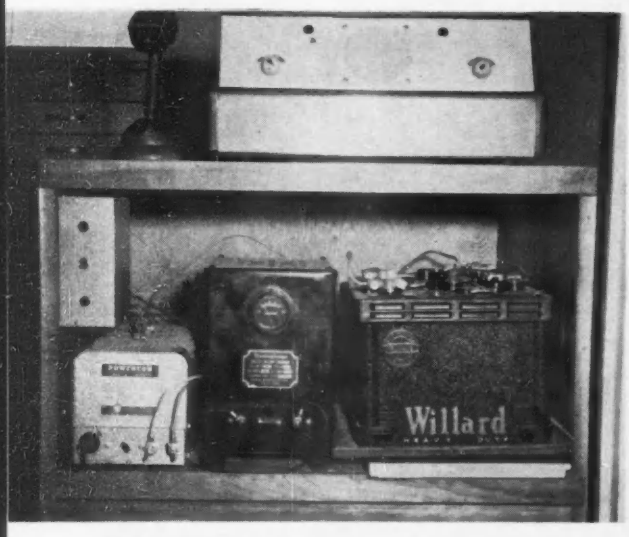
GENERAL ELECTRIC



Radio Changeover System Backs Up Master Station Power

CHARLES HOWARTH, Meter Foreman, Public Utilities Commission of the City of St. Catherine, St. Catherine, Ontario, Canada

A changeover device for two-way radio insures field communication continuity in case of power failure at the master station of Public Utilities Commission of the City of St. Catherine. In operation without trouble, and with a minimum of maintenance, for over a year, the emergency rig consists of a converter, a battery charger, two standard 6-v heavy duty car batteries, and a normally closed relay switching circuit.



The transmitter-receiver unit is rated at 10 w (115-v ac, 1.5 amp). The 6-v batteries are connected in series to provide 12-v to the input of the convertor. The convertor has a 110-v ac output, and is rated at 150 w continuous.

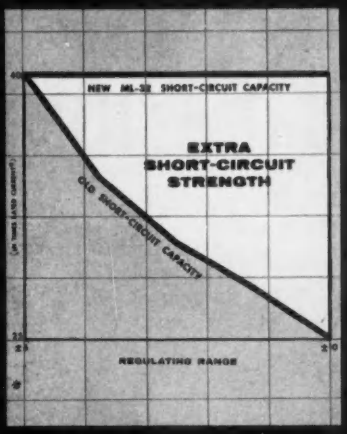
When the line 115 v ac is available, it energizes the relay which switch-connects the line voltage to power the radio and the battery charger, while connecting the output of the battery charger to the battery—the green pilot, located on the relay case, is lighted.

When the 115 v ac fails, the relay drops out and thereby switches the battery from the charger output line to the convertor (12 v) input line, while switching the radio power input line from the 115 v ac line to the convertor output (110 v ac)—the red pilot is lighted.

A simple testing circuit is included in the emergency changeover system. By "flipping" the test switch located on the relay case, the 115 v ac is deliberately interrupted, and the changeover from line power to converted battery power should take place. The green pilot should go out and the red pilot should be lighted. If the 12 v battery power is not then forthcoming, the red pilot will fail to light.

(*More EUM on page* 97)

SEVEN STEPS AHEAD IN VOLTAGE REGULATION



1 Increased short-circuit strength for longer regulator life

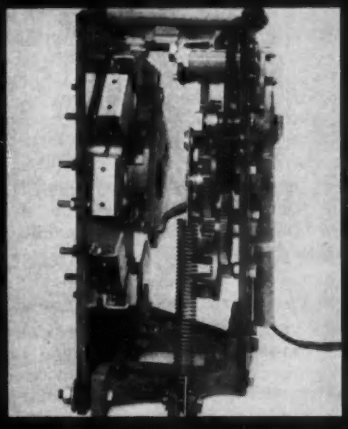
2 New Melalast cover finish increases protection against outages

3 New positive neutral indication protects linemen and equipment

4 Computer studies prove reduced bandwidths increase system earnings

5 New Permalex® coil insulation boosts reliability, lengthens life

6 New counter proves no increased operation at reduced bandwidth



7 Controlled switching speed maximizes contact life

1960 innovations emphasize General Electric leadership in voltage regulation

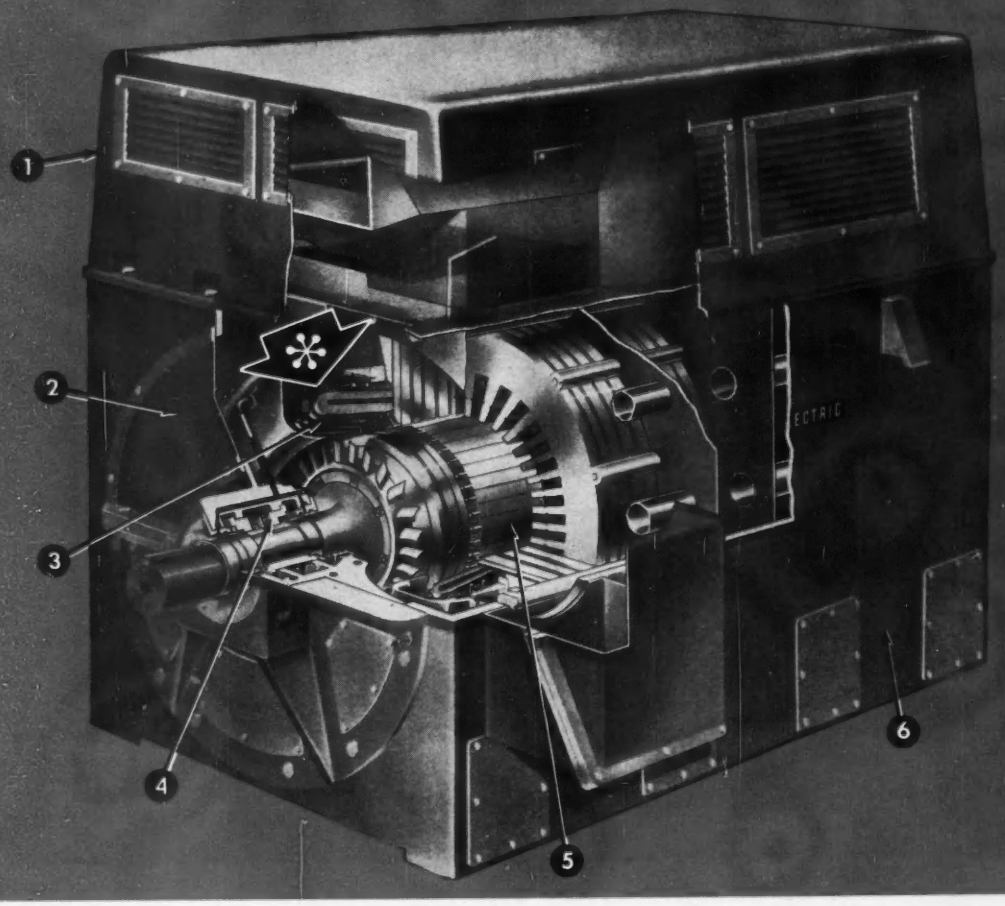
Watch for more to come in '61. Meanwhile, ask your G-E sales engineer for complete information about the full line of General Electric voltage regulators. Or, write General Electric Company, Section 456-6, Schenectady 5, N. Y. *Voltage Regulator Product Section, Pittsfield, Mass.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

NEW General Electric CUSTOM '8000' Boiler Feed Pump Motors . . .

CUSTOM DESIGNED FOR POWER STATION APPLICATIONS



1 REMOVABLE "TOP-HAT" provides easy access to motor interior. Top-hat is baffled and lined with sound absorbing materials to attenuate motor operating noise. Rotor and stator are constructed to reduce noise and direct sound waves into the acoustically treated top hat.

2 NEW END SHIELD DESIGN reduces time required for inspection and maintenance. One man can quickly unbolt and lift off the upper end shield half and remove the split air deflector. Bearing support is integrally cast with the lower end shield. Lower half of bearing can be "rolled out" for inspection without removing end shield.

3 EXCLUSIVE POLYSEAL* SUPPORTED SILICONE RUBBER INSULATION SYSTEM provides superior mechanical, thermal, voltage and environmental endurance—affords top reliability in critical Electric Utility applications.

4 TRIPLE PROTECTED BEARING SYSTEM lengthens boiler feed pump motor life. A primary seal is formed by the ring mounted on each end of the bearing shell and adjacent oil slinger machined in the shaft. A multiple groove seal at each end of bearing housing acts as a second line of defense against dirt entrance and oil leakage. In addition to the slingers and close running labyrinth seals, G.E.'s new bearing system utilizes an *Air-Lock* seal in each bearing housing. Air at slightly higher than atmospheric pressure is piped to annular grooves at each end of the bearing. This air pressure acts as a third seal to keep oil locked in the bearing housing.

5 ROTOR PARTS ARE MACHINED TO PRECISION TOLERANCES and assembled using especially developed techniques to assure high-speed operational stability.

6 RUGGED FRAME ASSURES SOLID STRUCTURAL SUPPORT for stator, end shields, rotor and top-hat. Frame is precision machined to positively align motor parts.

GENERAL ELECTRIC'S "CUSTOMIZED" MOTOR manufacturing philosophy permits the design flexibility, and the adherence to quality control production standards, which assure Electric Utilities of optimum motor performance, reduced operating costs and lower first cost. In keeping with requirements of Electric Utilities, Custom '8000' boiler feed pump motors are available now in ratings to 10,000-hp. 883-01

* Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NEW

encapsulated connection harness increases mechanical strength, assures maximum motor reliability

General Electric's new encapsulated connection harness consists of two rings of insulated conductors encapsulated in epoxy resins. The larger ring contains motor leads and phase connections, while the smaller ring contains equalizer connections.

This new system provides greater strength and rigidity at the end turns and assures uniform coil connections. Rigid encapsulation prevents contact between conductors—eliminates insulation abrasion. The epoxy compound provides additional insulation for leads and connections.

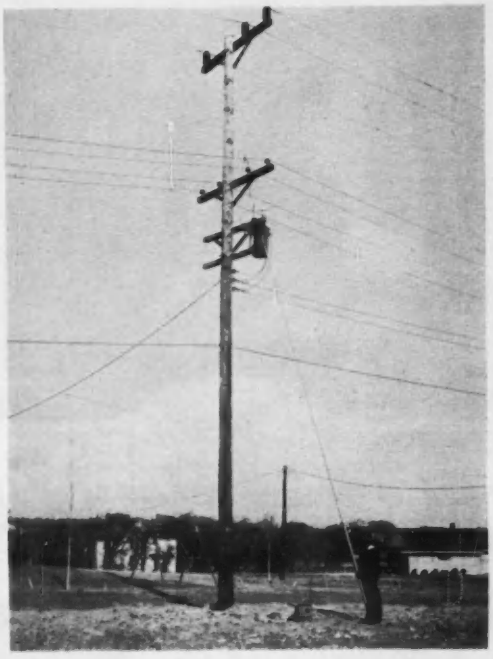
NEW ENCAPSULATED CONNECTION HARNESS for General Electric boiler feed pump motors provides an immobilized connection bundle . . . eliminates loose ties and abraided insulation.

YOUR GENERAL ELECTRIC APPARATUS SALES REPRESENTATIVE has full details on new G-E boiler feed pump motors. Call him today. Medium AC Motor & Generator Department, Schenectady 5, N.Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

OPERATIONS



Insulated Stick Solves Some Interference Woes

PAUL SHOUP, Radio Engineer—AEP System, Ohio Power Co, Canton, Ohio

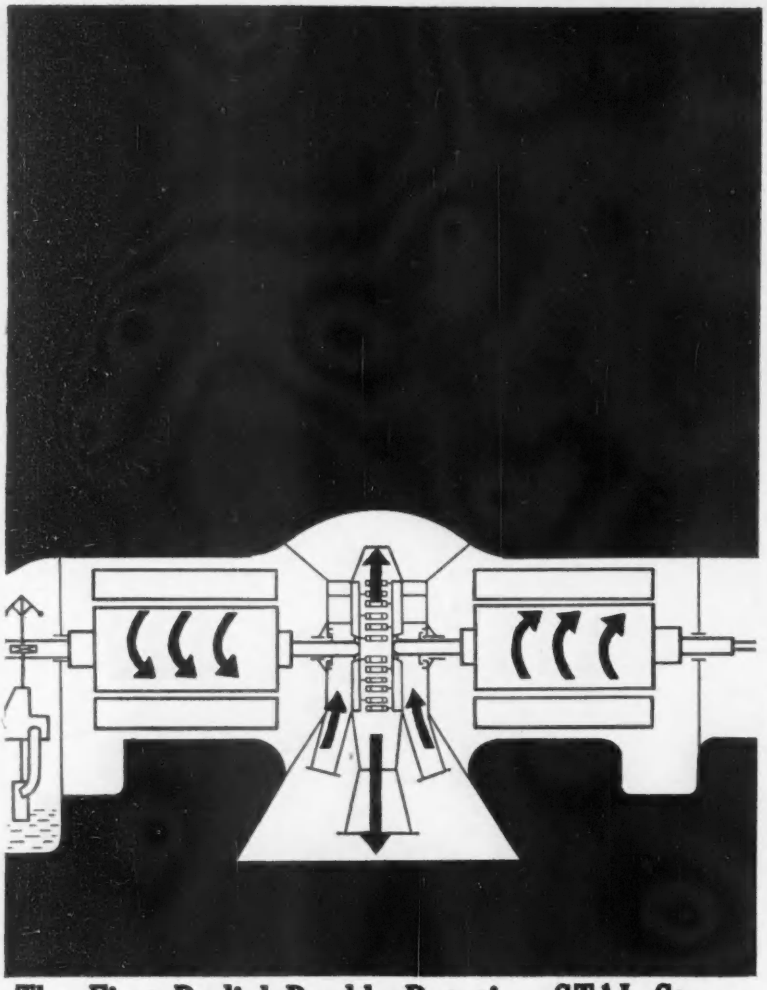
At Ohio Power Co a new approach, plus a telescoping hot stick, locates and eliminates radio interference without calling a line crew to climb poles. The new method will save many man-hours per year and has been helpful in clearing up 50% of interference causes.

Formerly, when tracking down television or radio interference in residential areas, the help of line crews was required. A radio engineer would first pinpoint the trouble spots, using mobile instruments, and sometimes "thumping" on poles with a hammer to see where loose hardware might be causing the problem. Then he would arrange for a line crew to help locate the specific trouble and clear it up.

With the new approach the engineer, after tracking down the overall trouble spot, manipulates an insulated telescoping stick to move the wires and/or equipment slightly—all the while observing the portable noise meter. In this way the specific cause of the trouble is generally located, and in most cases cleared up. For example, the stick has been used to slightly rearrange cutout-to-transformer leads and to increase clearance between lightning arresters and hardware—to solve an RI problem.

Faulty contact from loose hardware and various types of primary dead ends can also be corrected or improved by this method. A slight movement of the assembly with the stick will re-position hardware enough to clear up the interference in many cases.

In other instances, moving hardware may be only a temporary cure, but it does provide immediate relief until more permanent steps can be taken.

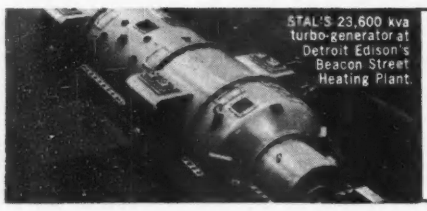


The First Radial Double Rotation STAL Steam Turbine In The United States

The last word in thermodynamic efficiency, lowest space requirements, inexpensive foundations, and low crane costs is Sweden's Radial Double Rotation STAL Steam Turbine. Designed to meet the most demanding requirements, STAL Steam Turbines are installed in power stations the world over with unparalled success. The ease of handling and simplicity of operation will make the Radial Double Rotation Turbine a favorite with power stations, paper mills, chemical plants and hundreds of other users in industry here. For free illustrated booklet and list of the major installations write to: ASEA ELECTRIC, INC. 500 Fifth Ave., New York 36, N. Y./55 New Montgomery St., San Francisco, Cal.

U.S. Representatives DeLaval-Ljungström Turbine Co.

ASEA



STAL'S 23,600 kva turbo-generator at Detroit Edison's Beacon Street Heating Plant.

Specifications

Make	STAL
Type	Radial flow double rotation
Throttle Steam Conditions	870 psig, 700F
Maximum Throttle Flow	500,000 lbs/hr.
Heaviest Life During Erection	21.5 tons
Turbine Heat Rate	3506 Btu/kwhr
2-3600 rpm Generators	Air Cooled
Power Factor	0.85
Back Pressure	150 psig
Rating	23,600 kva (combined)

Pressure Suppression

(*Continued from page* 72)

tangular reinforced concrete structure located immediately north of the turbine building and above the reactor caisson. This structure covers the shield plug and access hatch to the reactor head and houses the spent fuel pit, the new fuel storage facilities and other miscellaneous equipment.

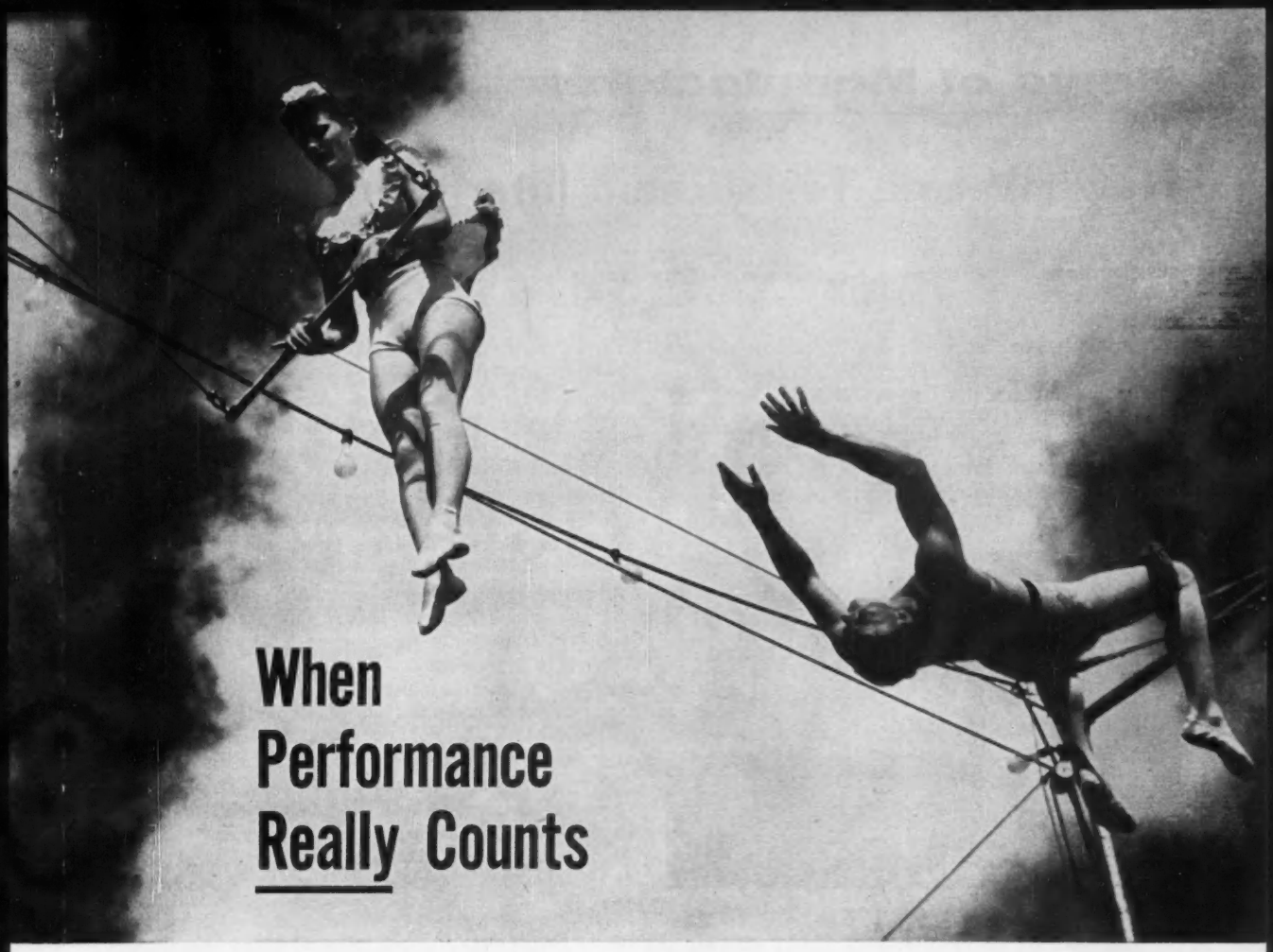
Refueling is done visually by personnel handling the fuel through a shield of water. The reactor is shutdown for refueling, the dry well is opened, and the reactor vessel head is removed. A refueling extension tank is placed on top of the vessel flange. The platform on top of the extension tank is used by personnel during the refueling operation.

To remove a fuel assembly from the reactor, the operator on the refueling platform first attaches a grapple to the handle of the fuel assembly, and the fuel assembly is lifted into a transfer cask. The plug at the bottom of the cask is then closed manually, sealing the water into the cask. The water provides adequate cooling of the fuel assembly during the time it is being transported by the overhead crane to the spent fuel storage pool.

Disposal facilities are provided on the site for solid, gaseous and liquid radio-actively contaminated wastes generated within the plant. All waste disposal will be performed in accordance with AEC, state and local regulations.

Dry solid wastes which will include defective equipment, trash collected within the plant, and the spent radioactive waste filter are discarded to an underground leak proof concrete vault for storage. Spent-ion exchange resins are sluiced from the reactor clean up and the radioactive waste demineralizers to a resin disposal tank in the radwaste facility.

Plant ventilation air and radioactive gases of process or ventilation system origin are diluted to the atmosphere through a 250-ft high exhaust stack. Radioactivity at the stack will be checked constantly by monitoring equipment which will annunciate if an excessive level is reached. A comprehensive system will be provided to collect, handle, treat and dispose of liquid radioactive wastes generated within the plant.



When Performance Really Counts

• Southwire Galvanized Steel Strand

STRAND SIZE	5/8"	1/2"	7/16"	3/8"	5/16"	9/32"	1/4"	3/16"
WEIGHT PER 1000'	813 lb.	517 lb.	399 lb.	273 lb.	205 lb.	164 lb.	121 lb.	72.9 lb.
MINIMUM BREAKING STRENGTH IN POUNDS								
ASTM A-122-54T								
Galvanized (Single Galv.) Common	11600	7400	5700	4250	3200		1900	1150
Class A (Double Galv.) Common	11600	7400	5700	4250	3200		1900	1150
Class A (Double Galv.) Siemens-Martin	19100	12100	9350	6950	5350	4250	3150	1900
Class A (Double Galv.) High Strength	29600	18800	14500	10800	8000	6400	4750	2850
Class A (Double Galv.) Extra High-Strength		26900	20800	15400	11200	8950	6650	3990
Class A Utilities Grade, A.T.&T. and Western Union Spec.—7-wires		25000	18000	11500	6000*	4600		2400**
ASTM A-363-55T (No welds)								
Weldless High-Strength		18800	14500	10800	8000			
Weldless Extra High Strength		26900	20800	15400	11200			

*weight per 1000'—225 lbs. **weight per 1000'—80.3 lbs.

Trapeze artists defy death to please the crowd, but they never take chances with faulty equipment. Care beats dare by far.

So it is with Southwire Galvanized Steel Strand. Manufactured under stringent standards of quality control, it meets or exceeds applicable ASTM specifications . . . is preformed to eliminate flared ends when sheared. Quality extends even to reels which are premium non-returnable type. Comes in 250', *500', and 1,000' coils, and in 2,500', *5,000' and 5,280' reels. Special packaging to meet your requirements is available.

Specify Southwire Galvanized Steel Strand for ground, messenger and guying applications and be sure of quality.

Stock items

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene, Polyethylene, and VWP (Vinyl) Weatherproof Copper, Aluminum and Triplex
- U.R.C. (DBWP, TBWP) Copper
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Galvanized Steel Guy Strand and Static Wire
- Aluminized Steel Guy Strand and Static Wire
- Aluminum Alloy Wire
- Cable Accessories
- NM Sheathed Cable
- THW Building Wire

• ALSO FABRICATORS OF COPPER AND ALUMINUM FOR WIRE AND CABLE MANUFACTURERS

Southwire Company

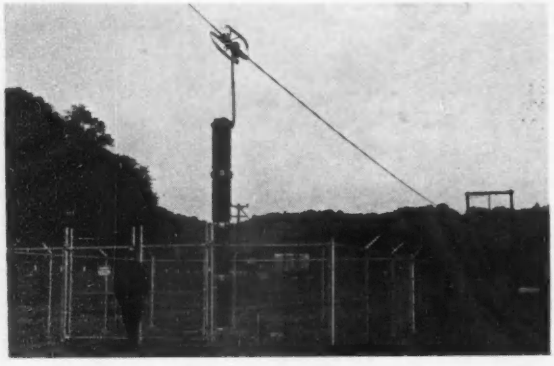
Carrollton, Georgia—TErrace 2-6311

New HV Line Tests Radio Interference

A single-phase, high-voltage experimental transmisssion line has been built by Westinghouse Electric Corp at Trafford, Pa., to study radio interference and corona loss. The line is energized from the company's high-voltage laboratory and operated at voltages up to 200 kv to ground (345 kv phase to phase).

The half-mile line has two sections, end to end, with about 1,550 ft of 0.721-in. conductor and 1,080 ft of 1.108 in.

First important investigation made with the new test line was to determine the effectiveness of a new design of decoupling or filter network to isolate one portion of a transmission line from another with respect to radio interference (or radio influence) noise.



The T-form filters (left), consisting of two resistors in series with the line and with the midpoint between them grounded through a large capacitor, were located between the two line sections. One resistor approximately matches the surge impedance of the line; the other is of arbitrary but much higher value—to isolate the end of the line section.

Noise was generated on the smaller conductor and then measurements made of the noise transmitted through the filters to the larger conductor.

Test results show the new design will provide a high degree of radio interference isolation between line sections, comments J. K. Dillard, manager of electric utility engineering for the company. "We expect similar units to contribute significantly to investigations we will make in the near future on an EHV test project the company is now engaging in at another location."

He explained that the new line will be used, also, to study: (1) fundamentals of generation of corona losses; (2) propagation of radio interference waves along transmission lines; (3) improved instrumentation for measuring and studying radio interference and corona; and (4) new ideas for suppression or reduction of radio interference and corona losses.

Prestressed Concrete Tower Erected for Project EHV

This 74-ton, 99-ft-high, prestressed, concrete transmission tower has been erected at General Electric Co's Project EHV, near Pittsfield, Mass. Fourth in a series of 18 towers which will be erected at GE's 4½-mile outdoor laboratory, it will carry power at up to 750 kv. Materials being used for the seven basis tower designs, along with concrete, are steel, aluminum, and laminated wood.

GE believes this tower is the largest of its kind and unique for several other reasons. Legs and the 93-ft crossarm are hollow, reducing overall weight. The legs are set 4½ ft into reinforced concrete sockets in the two tower bases—driven 80 ft into ground.

Pretensioned steel strands are used in the members to keep the concrete under compression. This has bowed the crossarm slightly upward; the arm will straighten when the conductors are attached.

The tower was supplied by Prestressed Concrete Institute, designed by Schupack & Zollman of Stamford, Conn., and made at New Haven by C. W. Blakeslee & Sons.

(*More News of Manufacturers, on page* 104)

DOSSERT UNDERGROUND CONNECTORS...

the versatile line

featuring:

- Fully molded, no factory taped joints.
- Insulated with MYPAR* rubber for higher quality and longer life, or MYPRENE* rubber for higher temperature resistance, and greater resistance to acids and oils.
- Made of high conductivity copper, insuring cool operation.
- Interchangeable with all standard underground connectors and their component parts.
- Made to fit standard compression tools.

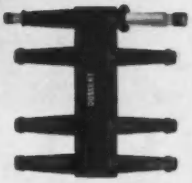
MICON* type MC

MICON COMPONENTS

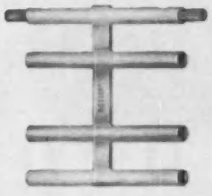
Tapered Compression Sleeve type C

Cable Receptacle type MA

Insulating Sleeve for MICON Outlet type MIS



Insulated Crab Connector type CBR

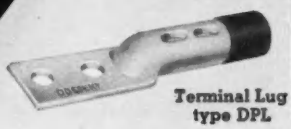


Uninsulated Crab Connector type CBN

MICON Stud Connector type MCBS

Limiter Link Assembly type LLA

Limiter Link Assembly type NLRA



Terminal Lug type DPL

Comp. Coupler type DPC

Comp. Tee Coupler type CRT

*U.S. Reg. Trade Mark

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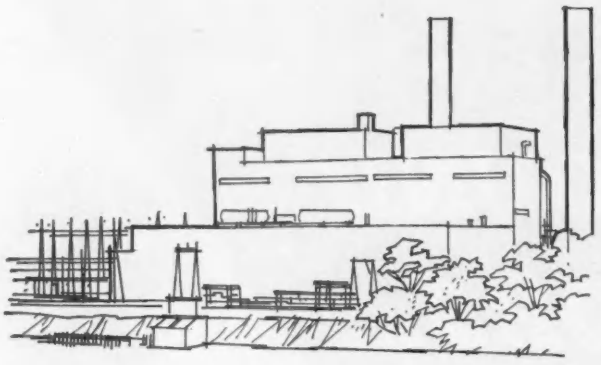
50 YEARS OF TECHNICAL KNOW-HOW

DOSSERT MFG. CORP.

249 Huron Street, Brooklyn 22, N. Y.
Representatives in all principal cities

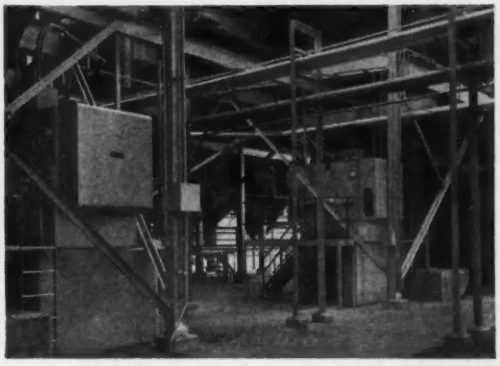


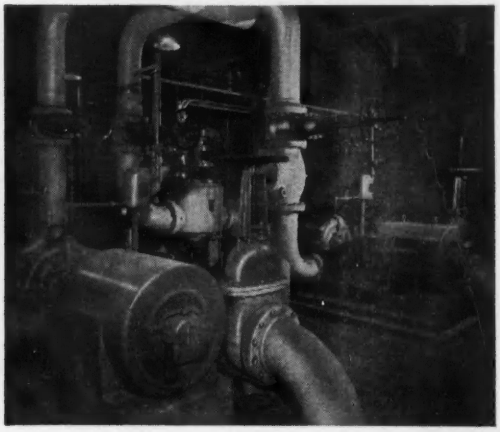
FOR 15 YEARS ELLIOTT EQUIPMENT HAS SERVED WEST PENN POWER

The new Armstrong Station includes Elliott motors—large and small—strainers and a deaerating feedwater heater—The West Penn Power Company has been served by Elliott ever since the first installation of Elliott machines in Springdale in 1945. Subsequent installations over the years took place at Mitchell, Milesburg and Armstrong.

Reliability and trouble-free service in all these plants were some of the reasons Elliott equipment was selected once again to serve the power and steam generating systems in the recently-completed second unit at the Armstrong Station, as illustrated on these pages.

Outside the Armstrong Station, these two 800-hp, 720-rpm, weather-protected type 2 Elliott induction motors are equipped with easily-accessible, cleanable filters.

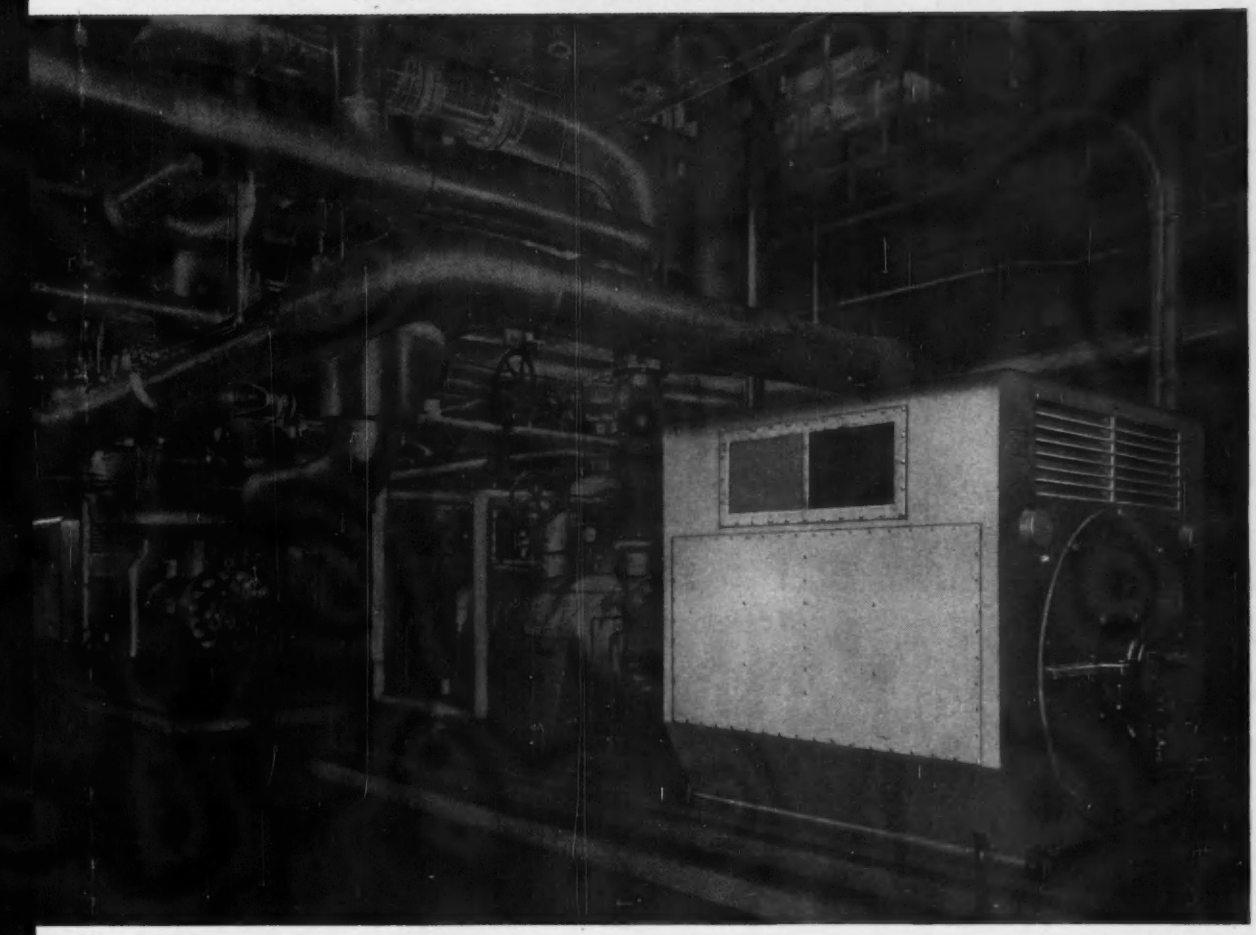


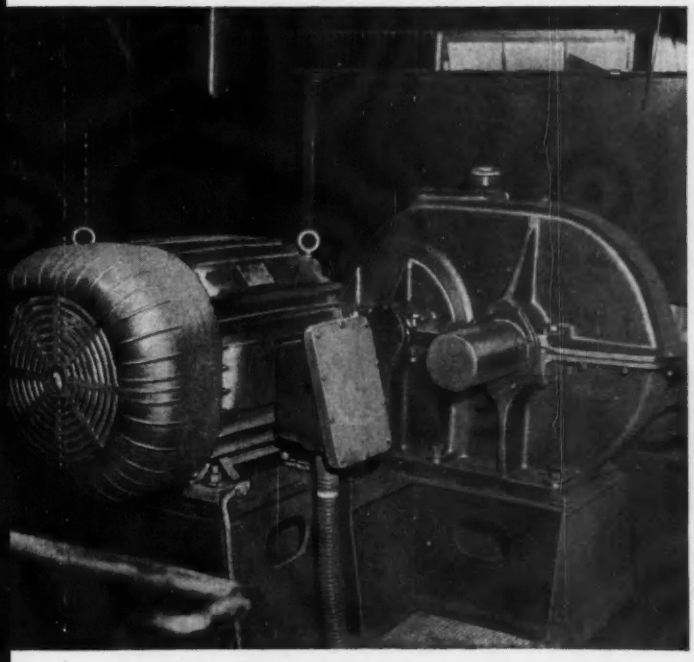


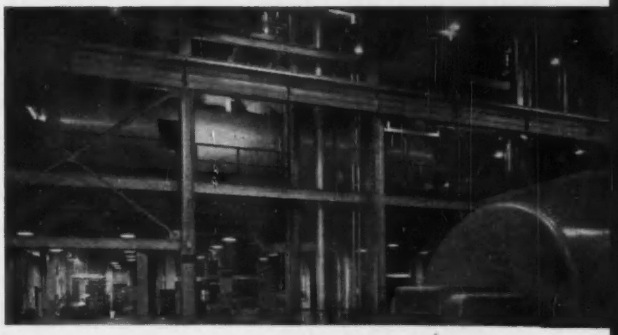
150-hp, 1800-rpm Elliott C-W motors drive low-pressure service water pumps. In the background is a 14-inch self-cleaning Elliott strainer. Other Elliott motors and strainers are used in water handling.

ELLIOTT Company
JEANNETTE, PENNSYLVANIA

Shown below are two Elliott Company super-quiet 2-pole boiler-feed pump motors, rated 2500 hp at 3600 rpm. Their quiet operation contributes appreciably to employee comfort.

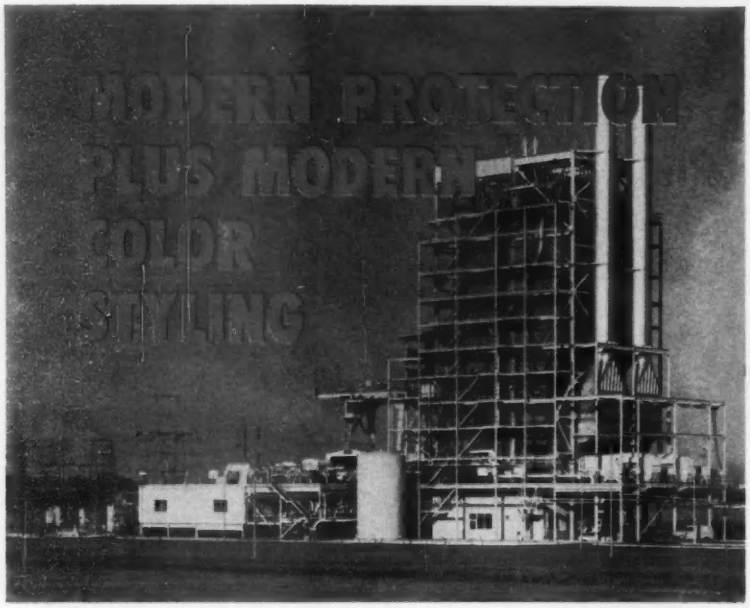






A direct-contact, tray-type Elliott deaerating feedwater heater is mounted on top of the 30,000-gallon storage tank seen above. Heater rating is 1,164,000 lb. per hour at design pressure of 30 psig and 5 in. Hg absolute. Elliott was the first to advocate deaerating heaters to prevent corrosion to water handling equipment.

A totally-enclosed 75-hp, 900-rpm Elliott Crocker-Wheeler motor, driving a coal breaker. Numerous Elliott C-W motors drive coal handling equipment in this plant.



SUBOX PAINTS

Corrosion protection has too long been associated with drab appearance. Now you can paint to have modern protection plus modern color styling.

Subox paints are now blended in a range of tones which make it possible to decorate property and make unsightly structures pleasing. Give your own good taste free rein.

Regardless of the colors you choose, you will be assured of the most tenacious kind of corrosion protection. Subox paints are the only American paints made with *suboxide of lead.* They remain chemically active, even after drying, to form an interlocking fibrous film that withstands the most punishing exposures.

Subox paints are very economical. One or two coats do the work of two or three of ordinary paints. And a Subox application lasts an average of 6 to 8 years.

Send for color card and literature.

SUBOX PAINTS

Subox Inc.
Trade Mark

Established 1924
3 Fairmount Plant, Hackensack, N. J.
Subox Company of Canada, Weston, Ontario

Transformers Provide Well Pump Circuit

Wagner Electric Corp recently built a number of special rural-line distribution transformers for Federated Rural Electric Assn of Jackson, Minn., using a separate 240-v circuit for operating well pumps.

In case of fire, and should it become necessary to open the secondary circuit breaker of the transformer to disconnect the feeders to the house and barns, the pump circuit remains energized so that water remains available.

Working with FREA through representatives of Dolan-Feldhaus Co, a transformer distributor, Wagner engineers developed this compact, self-contained transformer which provides the two circuits needed. It is a 10 kva, 7200/12470Y to 240/120-v unit with a conventional core-and-coil assembly protected by a secondary circuit breaker with external operating handle. Service to the house, barn, and other buildings is supplied through the breaker and can be cut off if necessary.

The separate 240-v circuit for the pump, remaining operative as long as the power to the transformer is not interrupted, is taken off ahead of the breaker and brought out to two additional low-voltage bushings through a current transformer used for metering. The current transformer is mounted inside the tank, with its leads also brought out through the tank wall.

I-T-E Launches New Line Of Interrupter Switchgear

Acting on today's trend among industrial plants for in-plant distribution of primary power to unit substations, I-T-E Circuit Breaker Co, Greensburg, Pa., has introduced a new line of fused interrupter switch-

how good should power cable be

...*for dielectric strength?*

At CIRCLE, the point is not how well specifications are met—but rather *how far they can be exceeded!* Take, for example, the well-known "double voltage test" as required by IPCEA-NEMA.

IPCEA-NEMA Performance Requirements

"6.5.3 After the sample has been immersed for at least one hour, it shall withstand for 5 minutes a test voltage which is twice the test voltage given in Table 12."

"6.5.4 . . . starting with the voltage at which the test described in 6.5.3 was made, the voltage shall be raised in steps of approximately 20 per cent of the immediately preceding voltage until failure occurs, the voltage to be kept constant at each step for 5 mintues."

"Circlesheath® Type RR Power Cable Performance"

The following table describes the performance of three samples of Circle butyl-insulated Type RR power cable.

CABLE SIZE	RATED VOLTAGE	DOUBLE AC TEST VOLTAGE	CIRCLE B'KDN VOLTAGE	MAXIMUM STRESS IN VOLTS PER MIL
2 AWG	5KV	28KV	48.3KV	454
1/0 AWG	5KV	28KV	40.3KV	356
500 MCM	5KV	31KV	44.6KV	307

A Circle power cable, subjected *for over two years* to a 250% overload of rated voltage in a *test still in process*, continues to meet all specified requirements.

Turning out high-reliability power cable requires expert knowledge of compounds, absolute quality control—and men who *know enough* to produce the very best. Next time you specify power cable, ask for Circle—there's no finer made.

CIRCLE WIRE & CABLE CORP., Maspeth, N. Y.

Circle CIRCLOC® Interlocked Armored Cable combines flexibility with mechanical protection in one lightweight, economical construction. It trains easily over obstructions; is ideal for future plant expansion. Available in galvanized steel, bronze or aluminum armor—from 600 to 15,000 volts.

CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

RUBBER COVERED WIRE & CABLE • VARNISHED CAMBRIC CABLE •
PLASTIC INSULATED CABLE • NEOPRENE SHEATHED CABLE • CIRTUBE® EMT

Installation of 60-PCL-23 C&D PlastiCal® Control Battery at new 75,000 kw Harbor Station, United Illuminating Co., Bridgeport, Conn.

United Illuminating Co. uses C & D PlastiCal® batteries for the critical job of control

By any check—capacity, convenience, economy, life—C & D PlastiCal® batteries can't be matched, when it comes to supplying instantaneous, dependable power for critical control applications.

Here at the new Harbor Station of The United Illuminating Co., Bridgeport, Conn., C & D PlastiCal control batteries have four important jobs:

1. operating control relays, pilot lights, and signals on the control board;
2. providing d-c emergency lighting;
3. closing and tripping circuit breakers;
4. emergency operation of bearing oil pumps, and main steam valves.

PlastiCal takes these important assignments in stride. Specifically engineered for control duty, this advanced-design lead-calcium plate battery has the high capacity necessary to sustain full load, when required.

PlastiCal works five times as long as conventional batteries without need for water—requires less charging current. And, PlastiCal has a life expectancy of 25 years in full-float operation.

More and more utilities are realizing the value of C & D PlastiCal batteries in control service. Ask your C & D representative for full details, or —

Send for Bulletin CP-540.

C&D C & D BATTERIES
of Conshohocken, Pa.
DIV THE ELECTRIC AUTOLITE CO

Manufacturers of Dyn-Glo® Industrial Batteries • Kathanode and Plantex® Batteries for Communications, Control and Auxiliary Power • Producers of Ionclad* • Silcon Chargers.

*Trademark

(*Continued from page* 104)

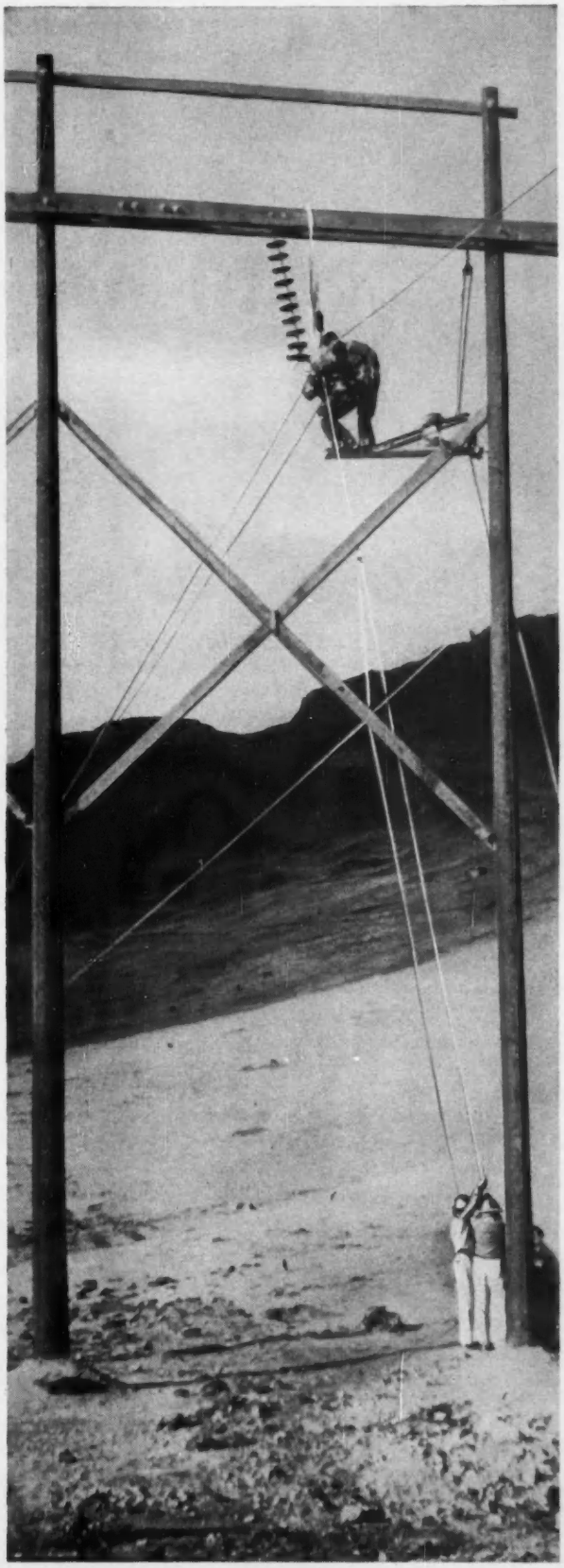
gear for both indoor and outdoor service entrance use from 5 to 15 kv.

The new power switching centers comprise a coordinated unitized metal-enclosed assembly of load-interrupter disconnect switch, external operating mechanism, and power fuse. They carry a single-device rating and are capable of switching continuous load currents

up to 600 amp and interrupting up to 780 Mva of fault current at 15 kv, under the new 1959 National Electrical Code requirements. Over 90% of commercial and industrial applications fall within this range. I-T-E's new centers are said to offer effective switching and short-circuit protection at 25 to 75% of the cost of circuit breakers for the same duty, depending on whether metering transformers are included. A snap-closed operating mechanism and design features on the load-break switch permit safe closing on a fault. The mechanism's spring energy forces switch closed, preventing malfunction, regardless of possible slow speed at which operator may move handle.

Auxiliary systems are available for use with the power switching centers that permit automatic throw-over from preferred to emergency supply and automatic return upon voltage restoration. Power switching centers equipped with instrument transformers, relays and compressed air operating mechanisms, can provide 95% approximation of circuit breaker performance, I-T-E claims.

(*More News of Manufacturers, p* 108)



Ebasco Planning– first step to economical electric systems

EBASCO engineers have been working with Utility Companies on the Industry's basic *and* knottiest problems of distribution, transmission, and generation for more than half a century.

Among the gratifying results has been a *lower system cost per customer* . . . as well as an increased efficiency, an improvement in methods.

But what of electric utility facilities today? What of *your* system? Demands for present and future needs are more exacting than ever . . . and in a period of generally skyrocketing maintenance, replacement, and expansion costs in other industries, EBASCO holds the line.

That's why many Utilities call on EBASCO for assistance. EBASCO has an unexcelled record in cutting costs through solid, knowledgeable system planning and unmatched, world-wide experience.

EBASCO engineers are thoroughly acquainted with methods, equipment, construction, operations . . . in *every* phase of the electric utility industry.

Our brochures describe EBASCO's services and how they may be of use to you. For copies, write Ebasco Services Incorporated, Dept. M, Two Rector Street, New York 6, N. Y.

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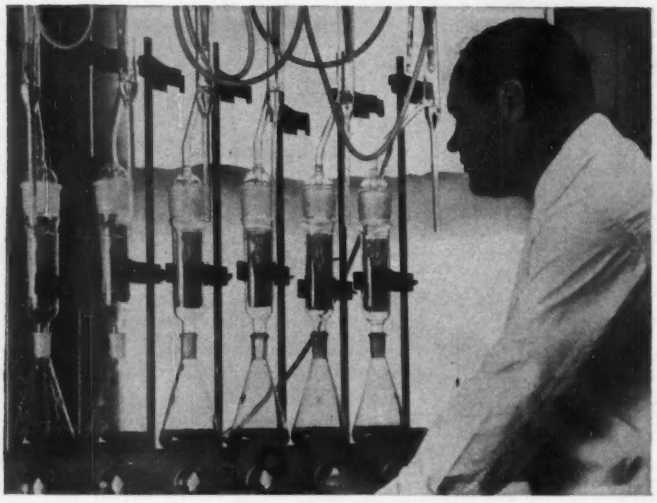
TECHNICAL BRIEF NO. 60-1

By D. L. DAVIES, *Manager, Technical Dept. Wood Preserving Div., Koppers Company, Inc.*

USE OF THE ASSAY METHOD TO DETERMINE RETENTION IN POLES



PRESENT STATUS

The Assay Method of determining preservative retention in pole charges has been described in Koppers Technical Bulletins W-101 and W-102. Following is the status of the Assay Method as a replacement for the less accurate gauge method of determining preservative retention.

The Western Electric Company, Inc. over 2 years ago made the Assay Method a part of its specifications on all new pole contracts. This major specification change was adopted to eliminate "weak sister" charges — charges which meet standard specifications by other measurement tools, but which in reality do not contain sufficient preservative to provide long-lasting protection.

The Rural Electrification Administration in April, 1960 issued new specifications which make mandatory that determination of retention in poles be made by the Assay Method. Many REA utilities have suffered financial loss from premature pole failures. They, too, want to eliminate the "weak sisters".

The Federal Government has a tentative specification TT-W-571f, now being reviewed by industry, which also calls for the Assay Method for determining retention (without alternates) in both poles and piles.

The AWPA adopted the Assay Method for determining retention in poles as a "full standard" at the April 24-26, 1960 meeting.

HOW TO APPLY THE ASSAY METHOD

In applying the Assay Method to poles, the specifications require that the outside ½" of the pole section be discarded. This section usually contains about 14-lb. preservative per cubic foot. Specifications further require that the next 1½" be assayed for retention. Therefore, an 8-lb. normal gauge retention charge must have a minimum of 6-lbs. per cubic foot in this zone. A 10-lb. treatment must have 7½ lbs. and a 12-lb. treatment must have 9-lb. in the assayed zone. No undertreatment allowance is permitted. Adoption of these retention requirements represents the most significant advance in standards for pine pole treatment since the adoption of 2½" or 85% sapwood penetration requirement in the late 1930's.

ANY COMPANY CAN ADOPT THE ASSAY METHOD

The status of the Assay Method for determining retention has advanced to the stage that any company can adopt it by a simple notation on the purchase order specifying that "poles are to be treated to a retention of *x* pounds/cubic foot as determined by assay".

• • • • • • • • • • •

For the full report on using the Assay Method, or answers to technical questions on poles or pole treatment, write: Koppers Company, Inc., Wood Preserving Division, Technical Dept., Room 748, Koppers Building, Pittsburgh 19, Pa.

C-45

KOPPERS
PRESSURE-TREATED WOOD

Sea-Water Conversion Contract Awarded

Contract for one-million-gal-per-day sea-water conversion plant has been awarded to Westinghouse Electric Corp by the US Department of Interior's Office of Saline Water. Plant will be located at Point Loma near San Diego, Calif., and its daily output of one-million gal of fresh water will be purchased by the city of San Diego.

The Westinghouse heat transfer department will have full responsibility for the construction and start-up operation of the plant. The company will use its multi-stage flash distillation system to convert the sea water into fresh water.

Architectural-engineering services were handled by Fluor Corp, Ltd, of Los Angeles. Completion is scheduled within a year. Westinghouse will operate the plant for a shake-down period of 75 days, including 30 days at the full daily output. It is to be the largest multi-stage flash-evaporator plant in the US, says the manufacturer.

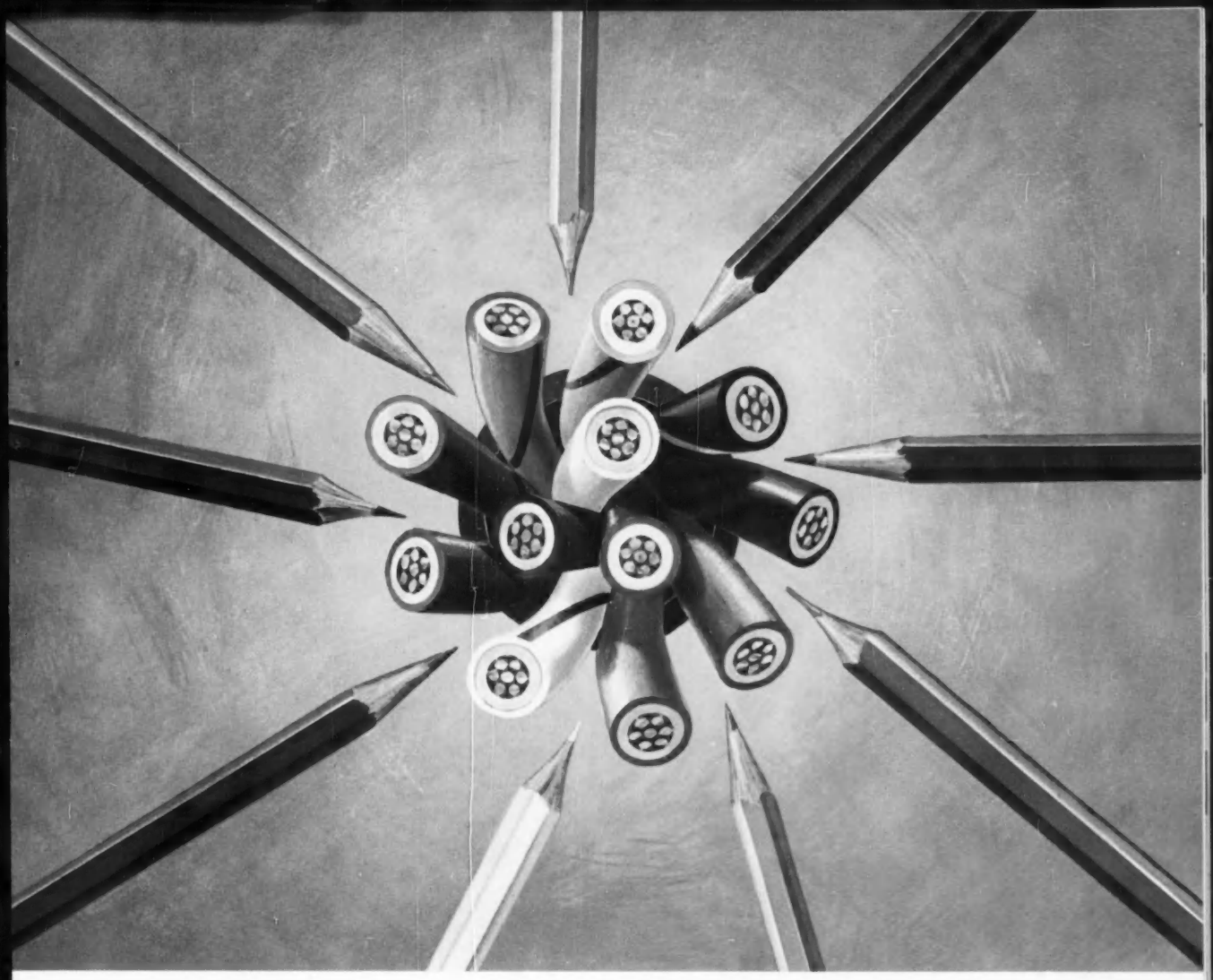
Electricity Generated From Geothermal Power

In using a 12,500-kw GE unit built in 1924 to generate electricity from geothermal power at Geysers plant of Pacific Gas & Electric Co, General Electric Co believes it is setting a precedent in the nation.

Until recently, the unit had been used at PG&E's Sacramento steam-electric plant. Because it was designed to operate at almost the exact steam temperature and pressures produced by the natural steam wells at the Geysers, Calif., PG&E had the steam turbine modified for use in its new Geyser Station.

MANUFACTURERS BRIEFS

Sangamo Electric Co's net income dropped 53% to $1,086,000 for the first nine months of 1960, compared to the same period last year. Sales for the period were virtually the same as last year's: $28,629,000 . . . **Kuhlman Electric Co** has purchased a 360,000-sq-ft plant in Warren, Mich., which it will use to process automotive and airplane parts starting next year.



DRAW YOUR OWN CONCLUSIONS

about the savings possible with this new, standard control cable from Rome

How many ways might a control cable save you money in your generating and substation?

First, by being *versatile*. And Rome's new standard control cables (designated as the CT line) are just that. You can use them with AC or DC circuits, at voltages to 600 (Type B), or 1000 (Type C), all in accordance with new IPCEA-NEMA standards. You pick the number of conductors you need, from 2 to 37, in No. 10 or No. 12 AWG copper. You install new CT in open air, in ducts, or conduit, in tray or trough. Or bury them directly in the earth.

Second, a control cable must *perform well*, under a variety of conditions, over a long period of time. CT cables will. Each conductor is insulated with polyethylene, so you can be sure that its dielectric performance is excellent, particularly where moisture might be a problem. This insulation also stands up to acids, alkalies and oils. Then there's the Synthinol (polyvinylchloride) jacketing over *each* insulated conductor and over the *entire* cable. It gives added resistance to heat and chemicals, and provides good mechanical protection for the insulation as well as a flame-retardant barrier.

Third, consider *installation*. CT cables are flexible, clean, lightweight and fully color coded. They are also *smaller* in over-all size than rubber-insulated cables. You can use smaller conduit and fittings, or put more conductors in existing conduit. And, color coding makes for quick, correct connections and facilitates subsequent testing and maintenance.

Get all the facts and figures—including details on which sizes are available "off the shelf!"—about Rome's new CT cable. Write now for complete specifications. Address inquiries to Rome Cable Division of Alcoa, Dept. EL-100, Rome, New York.

Special requirements? As a cable specialist, Rome can answer any of your control cable problems not met by this standard construction. Ask your Alcoa-Rome salesman for details.

ROME CABLE
DIVISION OF **ALCOA**

WHICH JOB WOULD YOU TAKE?

If you're like most of us, you'd take the job with the more tempting salary and the brighter future.

Many college teachers are faced with this kind of decision year after year. In fact, many of them are virtually bombarded with tempting offers from business and industry. And each year many of them, dedicated but discouraged, leave the campus for jobs that pay fair, competitive salaries.

Can you blame them?

These men are not opportunists. Most of them would do anything in their power to continue to teach. But with families to feed and clothe and educate, they just can't make a go of it. They are virtually *forced* into better paying fields.

In the face of this growing teacher shortage, college applications are expected to *double* within ten years.

At the rate we are going, we will soon have a very real crisis on our hands.

We *must* reverse this disastrous trend. You can help. Support the college of your choice today. Help it to expand its facilities and to pay teachers the salaries they deserve. Our whole future as a nation may depend on it.

It's important for you to know more about what the impending college crisis means to you. Write for a free booklet to: HIGHER EDUCATION, Box 36, Times Square Station, New York 36, N.Y.

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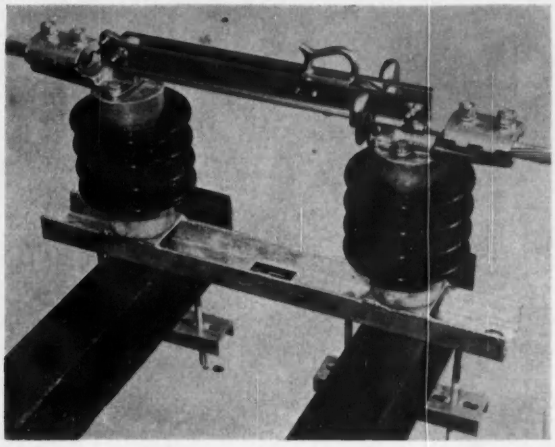
HIGHER EDUCATION
KEEP IT BRIGHT

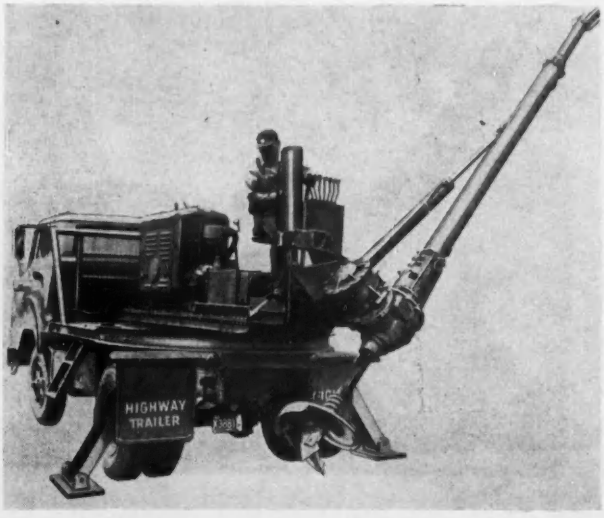


Hook Switches . . .

. . . for 7.5 to 23 kv, 400 and 600 amp, is suitable for single-crossarm, double-crossarm or station-structure mounting. The distribution hook switch is designed for use with portable load-break tools.
Memco Engineering & Mfg Co, Inc, Commack, N. Y.

Open Cutout . . .

. . . flexibility is improved by the introduction of two new fuse tubes and a new disconnect blade. The units for the type XS single vented cutout are a 200 and a 100-amp fuse tube and a 300-amp disconnect blade. The first is rated 12,000 amp asymmetrical interrupting capacity at 7.2 kv. The 100-amp ultra-heavy-duty tube has a 12,000-amp rating for five-shot duty and 14,000 amp asymmetrical for one-shot at 7.2 kv.
S&C Electric Co, 4435 N Ravenswood, Chicago 40, Ill.



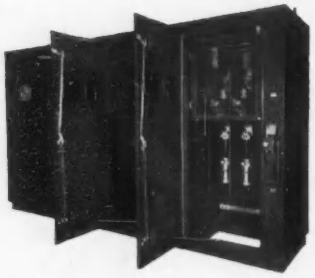
Hydraulic Digger . . .

. . . digs holes of 42-in. dia to 35 ft deep. Hydraulic or mechanical power leveling permits digging over a wide range of angles. All controls of the model HCBMS digger are by the operators seat. There are 110 and 120-v outlets for power tools.

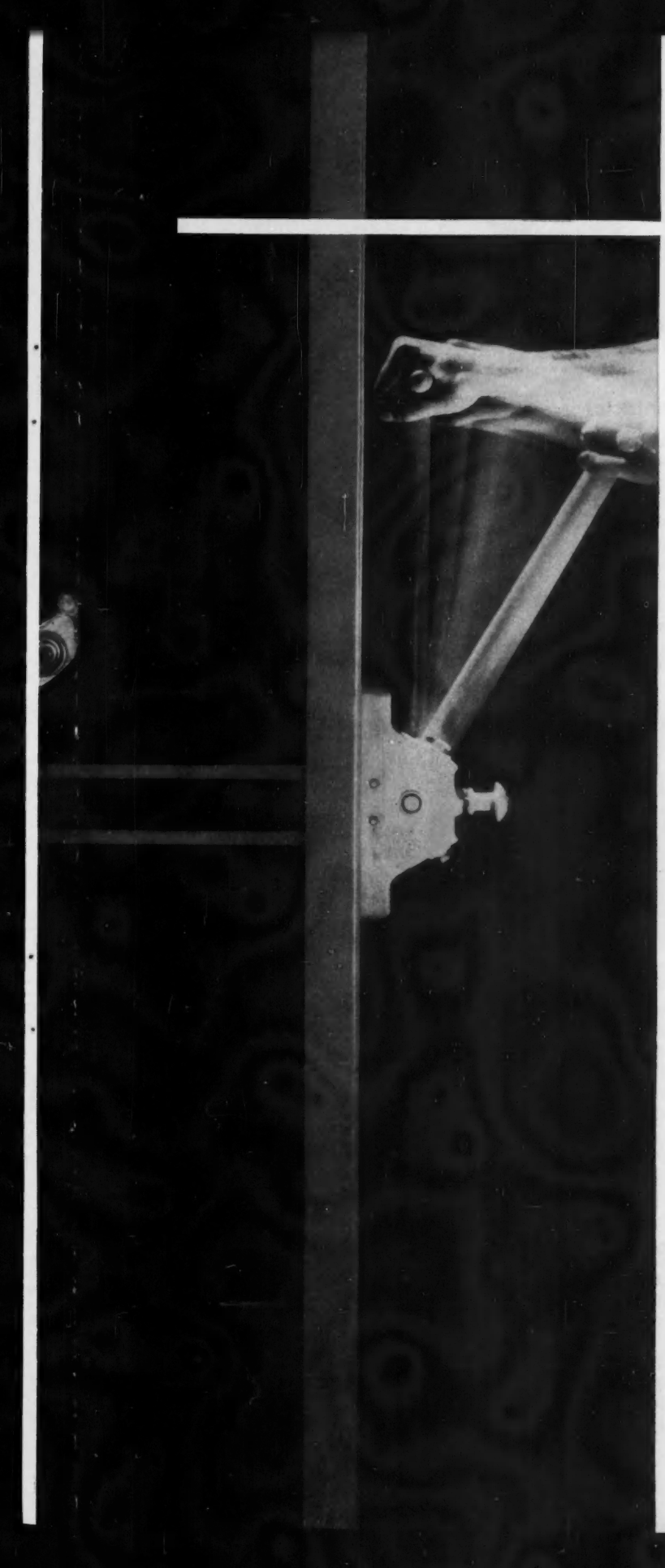
The model HFMS heavy-duty earth-boring machine (not shown) features a self-contained hydraulic Kelly bar that provides variable speeds in feed and retraction. It also digs at angles.
Highway Trailer Industries, Stoughton, Wis.

(*More New Equipment on page* 114)

FAULT CLOSING



S&C metalclad switchgear meets all requirements of new National Electric Code for fault closing, short-circuit interruption. Performance proved by high power testing at KEMA laboratories.



S&C metalclad switchgear can close on any fault up to 60,000 amps

No danger to equipment—no danger to operator even if he closes load interrupter switch on the heaviest faults. S&C's new line of metalclad switchgear is rated as high as 40,000 amps fault closing, 500 mva short-circuit interrupting at 14.4 kv. And at 4.16 kv, the corresponding ratings are 60,000 amps, 250 mva!

Here's how it works: 1) Fault never flows through interrupting unit when switch is closed . . . it flows through separate arcing contacts; 2) Arcing is minimized and magnetic forces are overcome by quick-make, quick-break toggle action no matter how slowly operator closes handle.

Short-circuit interrupting duty (up to 500 mva) is handled by a new boric acid power fuse, the Type SM, which features multiple bore construction to handle low, medium, and high faults.

The simplicity of the S&C design—power fuses for short-circuit interruption and load interrupters for manual or automatic load switching—enables you to save as much as 50 percent on your switchgear investment. Why not consider S&C Metalclad Switchgear for your high voltage power systems? In industrial plants and commercial and institutional buildings there are rarely any transient faults, so there is no real need for the automatic reclosing ability of the more expensive circuit breaker type of switchgear.

For more information please consult the telephone directory for your nearest S&C sales office.

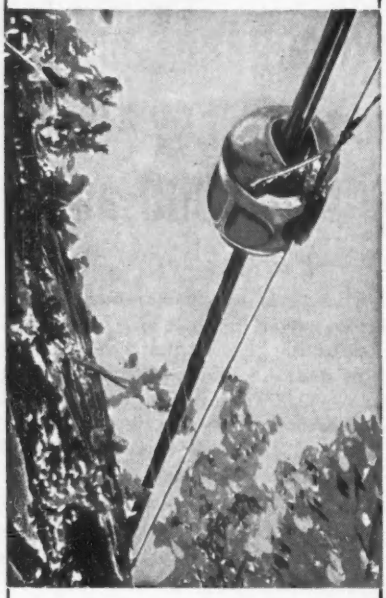
S & C ELECTRIC COMPANY

4421 Ravenswood Avenue • Chicago 40, Illinois

Specialists in High Voltage Circuit Interruption since 1910

S&C

END TREE-TRIMMING PROBLEMS



By using aerial (field spun) cable for distribution lines, practically all tree-trimming is eliminated during the installation and for the rest of the cable life.

The freedom from maintenance experienced with this type of installation makes it a very economical distribution plant.

★ ★ ★

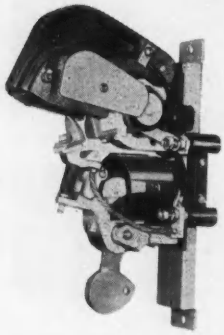
For descriptive literature on tools for spinning aerial cable, write or phone

★ ★ ★

Phone CE 2-7234

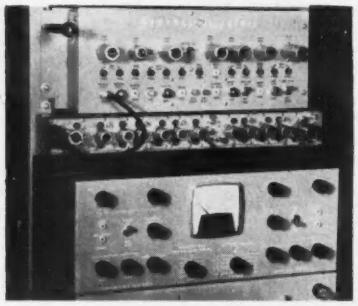
CABLE SPINNING EQUIPMENT CO.

Topeka Kansas



Dc Contactor . . .

. . . can be mounted on a spacer so that control wiring can be channeled under the contactor if wiring space is tight. Molded arc chutes and magnetic blowout structures provide long life and quick dissipation of the heat from arcing. Ratings are to 150 amp.
Cutler-Hammer, 235 N 12th St, Milwaukee, Wis.



Microwave System . . .

. . . for up to 240 voice channels operates in the range 5,925-7,450 Mc. The type UA-6B, basically a duplex radio transmission set, has integral test facilities for monitoring its voltages, currents and RF power.
General Electric Co, Box 4197, Lynchburg, Va.

Cation Resin Cleaner . . .

. . . removes contaminating coatings and silt in cation exchange resin beds in any installation that requires salt regeneration. Iron, aluminum, carbonates and similar coatings react with Permutit cation exchange resin cleaner No. 1112

(*Continued on page* 118)

Crapo
GALVANIZED STEEL STRAND HAS ALL **5**

1. *Strength*
2. *Workability*
3. *Ruggedness*
4. *Long Life*
5. *Economy*

When you select a size and grade of strand for a specific job you want to know that it meets every requirement of that job. You want ample strength to sustain the ultimate load—plus an adequate safety factor. You want pliability for ease of working in the field. You want ruggedness to withstand the abuse which may be encountered during and after installation. You want long, dependable life. And, you want reasonably low first cost and low maintenance costs.

For more than 50 years *Crapo* Galvanized Steel Strand has consistently demonstrated its ability to more than meet all of these requirements. Proof of its reliable performance is to be found in the case histories of overhead power and communication lines throughout the country.

Crapo Galvanized Steel Strand is fully protected against corrosion by heavy, uniform, dense coatings of commercially pure zinc tightly bonded to the individual wires. All grades and sizes are available in A, B and C weights of coating.

For details, ask our distributor or write direct!

INDIANA STEEL & WIRE COMPANY, INC.
Muncie, Indiana

HOW WESTERN PRECIPITATION'S UNIQUE "KNOW-HOW" BENEFITS YOU!

The science of dust, fume and fly ash recovery is a highly technical one. Moreover, the fact that there are a number of basic methods for separating suspensions from industrial gas streams – each with certain advantages and disadvantages – further complicates the basic problem.

Even two different plants cleaning the same type of gas may find that such variables as capital investment policies, maintenance and labor schedules, and other similar management functions may make one type of equipment the logical choice for one plant – a basically different type of equipment the best solution for the other.

That's why Western Precipitation's position in the gas cleaning field is so unique. It is the *only* organization that designs, engineers and installs *all* the basic types of gas-cleaning equipment. It is completely unbiased in its viewpoint, and is able to show you exactly how the overall costs, the collection efficiencies and the operating requirements will vary for each installation – with each type of collecting equipment that may be applicable.

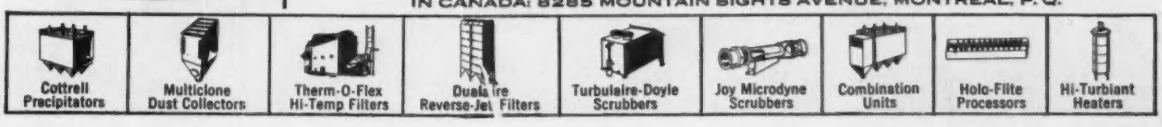
Such an unbiased evaluation is invaluable in assuring optimum returns from your gas-cleaning dollar. Best of all, this unique "know-how" costs you nothing. It is a basic part of Western Precipitation's service to industry throughout the United States, Canada and the Free World.

Our nearest representative will gladly place this unique fund of experience at your service. Why not call him today?

G-190

WESTERN
PRECIPITATION
DIVISION OF JOY MANUFACTURING COMPANY

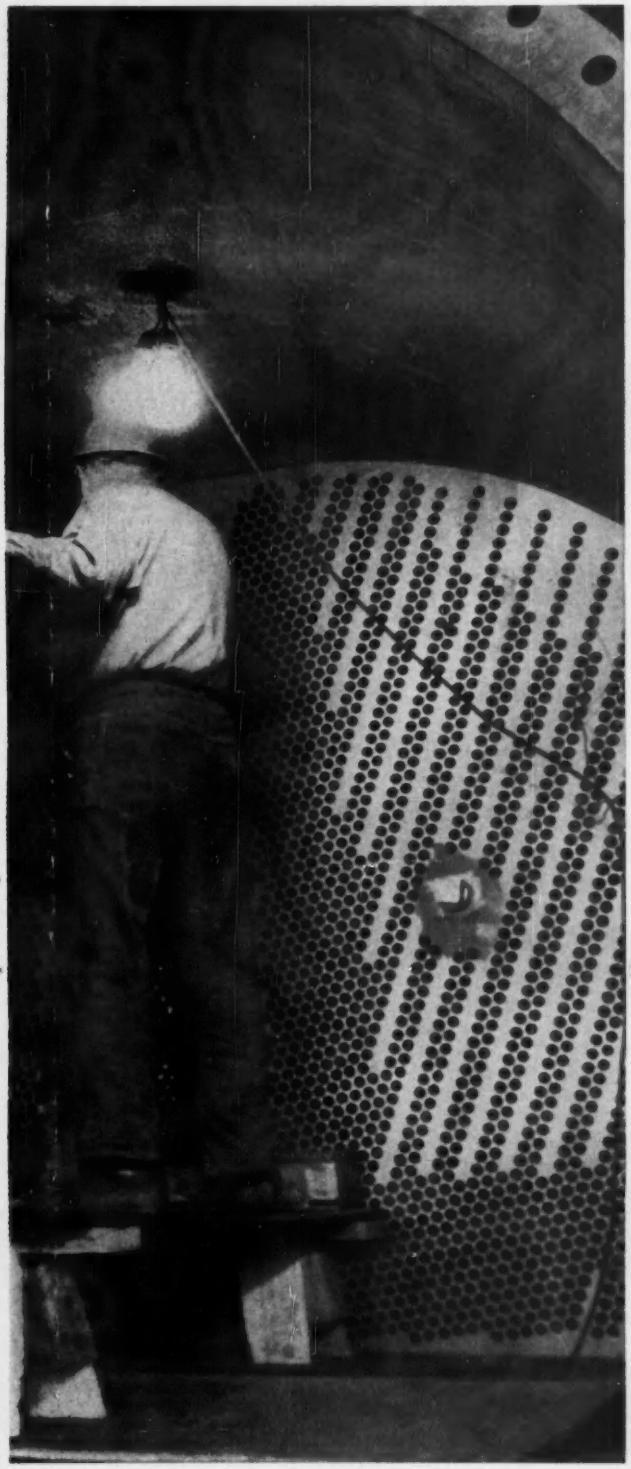
1000 WEST 9TH STREET LOS ANGELES 54, CALIFORNIA
NEW YORK 17 • CHICAGO 2 • PITTSBURGH 22 • ATLANTA 5 • SAN FRANCISCO 4
IN CANADA: 8285 MOUNTAIN SIGHTS AVENUE, MONTREAL, P. Q.



Don't tube up your condensers without calling Chase®

Unique Chase Condenser Tube Clinic

Provides Complete 8-Point Service



It's just plain common sense to talk to Chase first—before you order tube for original equipment or for retubing. Here's why: The Chase Tube Clinic has a special 8-point program that's ready to serve you in all these ways:

1. **WATER ANALYSIS** – either original or recheck, to help eliminate failure.
2. **TUBE FAILURE ANALYSIS**—by examination of sections of tube, determine why the failure and how to avoid repetition.
3. **CORROSION SERVICE**—predicts where to look for trouble based on the collected experience with water samples and service conditions from hundreds of areas all across the country.
4. **PRODUCT QUALITY CONTROL**—Chase tube meets rigid ASTM specs, and is given special Chase-developed electronic tests as well.
5. **WIDE ALLOY CHOICE**—Chase has the alloy available (brass, copper, aluminum, stainless or bimetal) to meet any combination of service conditions.
6. **STRATEGICALLY-LOCATED STOCKS** and mills can meet normal or emergency delivery schedules.
7. **APPLICATION ADVICE**—Chase tube engineering staff can help with design of tube sheets; welding or rolling-in installations; advice on use of inserts; selection of dual-gauge or thickened end tube, etc.
8. **PACKAGING TO SPECIFICATION**—When you order tube from Chase, it comes fully protected against damage, and in job-designed packaging to meet your exact specifications and installation needs.

Get in touch with the exclusive Chase Tube Clinic today—by calling your nearest Chase Representative, or by checking and mailing the coupon below.

Chase

BRASS & COPPER CO. WATERBURY 20, CONN.

Subsidiary of ***Kennecott Copper Corporation***

CHASE BRASS & COPPER CO.
DEPT. EW-11, WATERBURY 20, CONN.

Please send me the following literature:

☐ Condenser Tube ☐ Information on welding installations
☐ U. Bends ☐ Full details on how to take advantage of Chase Tube Clinic Service

NAME_____ TITLE_____

COMPANY NAME_____

STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

*Trademark

"Superforms* make my Budget Dollars go farther" ... PURCHASING AGENT

"We have to look at budgets as investments ... in terms of *return* ... all the way from negotiating and pricing, to having equipment available when needed for use.

"With Fanner Superforms, we get *prompt quotations* from the Agent and the Factory ... they *meet their commitments* ... give *reliable service.*"

These are reasons why more and more Purchasing Agents are buying more and more Superforms. A-1695A

FANNER
*Superformed** **with a**
"PROTECTIVE TWIST"

ARMOR RODS ...
Protect long-span T&D lines at supports

LINEGUARDS ...
Protect short-span T&D lines at supports

PATCH RODS ...
Repair damaged conductors

TAP ARMOR ...
Protects conductor at tapping points

FANNGRIPS ...
For dead-ending strands and conductors

FANNSPLICES ...
Join two ends of conductor wire

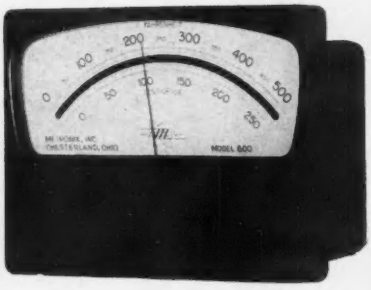
PLASTIC PRODUCTS ...
For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

Cation Resin Cleaner . . .

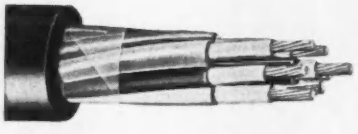
(*Continued from page* 114)

to form easily removed solubles, and the bed is restored to an efficient level. The cleaner dissolves rapidly in cold water. It is supplied in 10 and 100-lb containers and can be stored without special precautions against humidity.
Ionac Chemical Co, Birmingham, N. J.



Electronic Voltmeter . . .

. . . **with an input sensitivity** of 0.05 μa monitors temperatures measured by thermocouples as long as 10,000 ft. Model 600 dc all-transistor voltmeter, which has an input resistance of more than 100,000 ohms, operates on signals too small for an ordinary pyrometer. It is available in a variety of temperature and voltage ranges.
Metronix, Inc, Chesterland, Ohio.



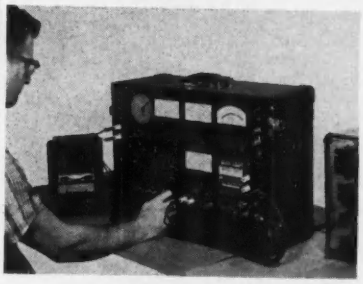
Plastic Control Cable . . .

. . . **especially for dc circuits** in wet locations and for temperatures to 75C is smaller and lighter than rubber cable. Three walls, insulation, protective covering and overall jacket, are all of high-quality dielectrics. The P-30 small-diameter cable resists chemicals, is tough physically and flame-resistant. It is suitable for installation in conduit or trays, as aerial cable or under direct burial.
Okonite Co, Passaic, N. J.
(*More New Equipment on page* 122)

DON'T BE OLD FASHIONED

Sprawling, complex, old fashioned relay test apparatus is hazardous, time-consuming and costly.

GO MODERN WITH MULTI-AMP® PORTABLE RELAY TEST UNITS



The use of MULTI-AMP compact relay test units offers all these advantages:

- fast set-up; rapid testing
- reduced man-hours; maximum safety
- complete portability; compactness
- simplified testing, metering, timing

MULTI-AMP INSURES CONTINUOUS POWER FOR CONTINUOUS PRODUCTION. Standard (0.1-2 kva) or custom models for every relay test requirement. Write for catalog RT-1 on protective relays. Other catalogs available: CB-1 (Circuit breakers); OCR-1 (Oil circuit reclosers); LB-1 (Load boxes).

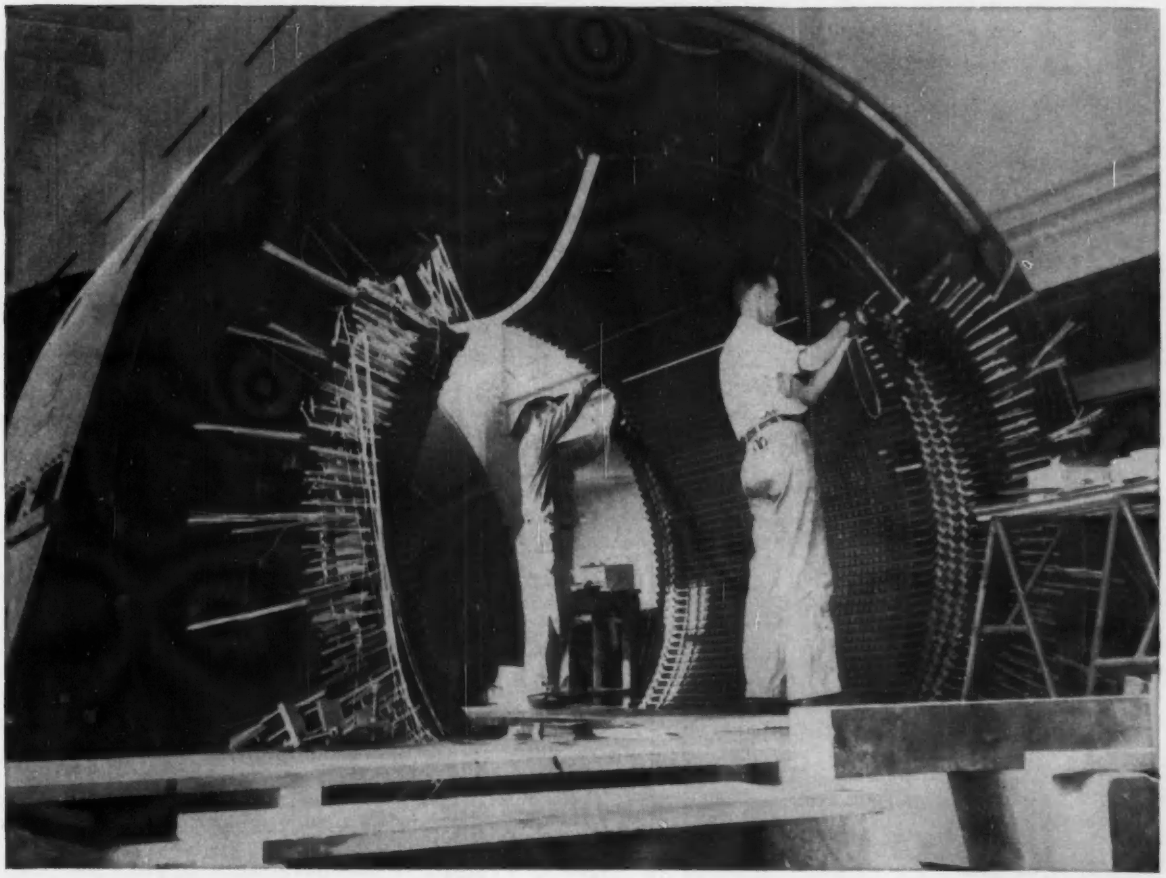
MULTI-AMP DIVISION
MULTI-AMP ELECTRONIC CORPORATION
465 LEHIGH AVENUE
UNION, NEW JERSEY
MUrdock 8-7112
MA/101

Stator capacity increased by rewinding with NECCOBOND coils by National... *the specialists in electric coils/repair service*

Stator capacity of this 37,500 KVA Synchronous Condenser was increased at no change in temperature rise when the machine was rewound with new NECCOBOND coils having more efficient copper-slot ratio. Complete service included coil design and manufacture, installation and test. In addition, revolving field coils were completely rebuilt, installed and tested.

Whenever *you* need service on rotating electric machinery—whether large or small, whether you need a few coils or a complete rebuilding job—contact National Electric Coil. Our service is fast, thorough and dependable.

For information call National's Columbus Plant, HUdson 8-1151 or check the nearest National Field engineer.



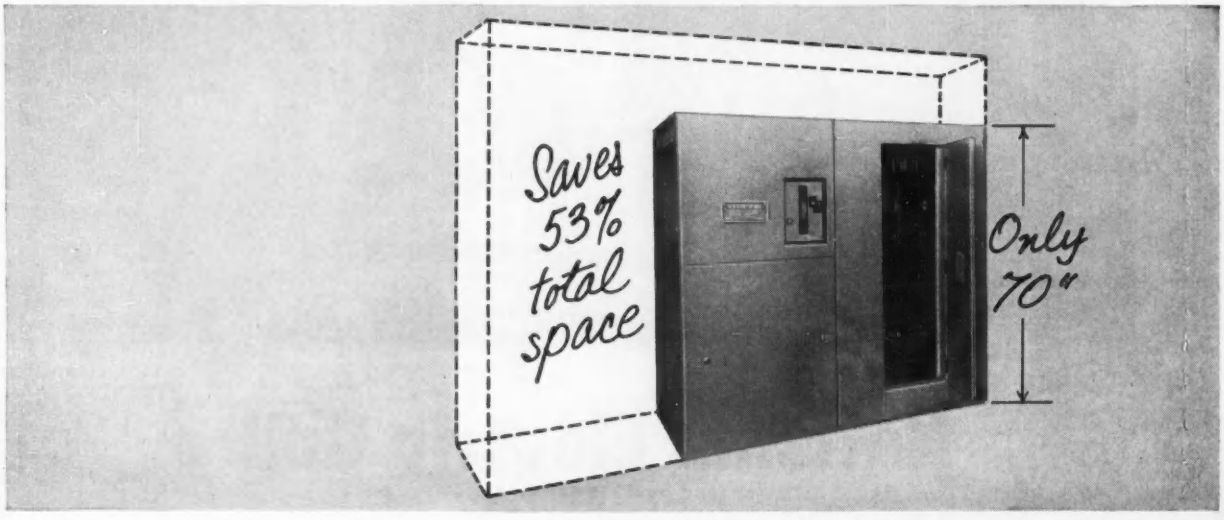
NATIONAL COILS

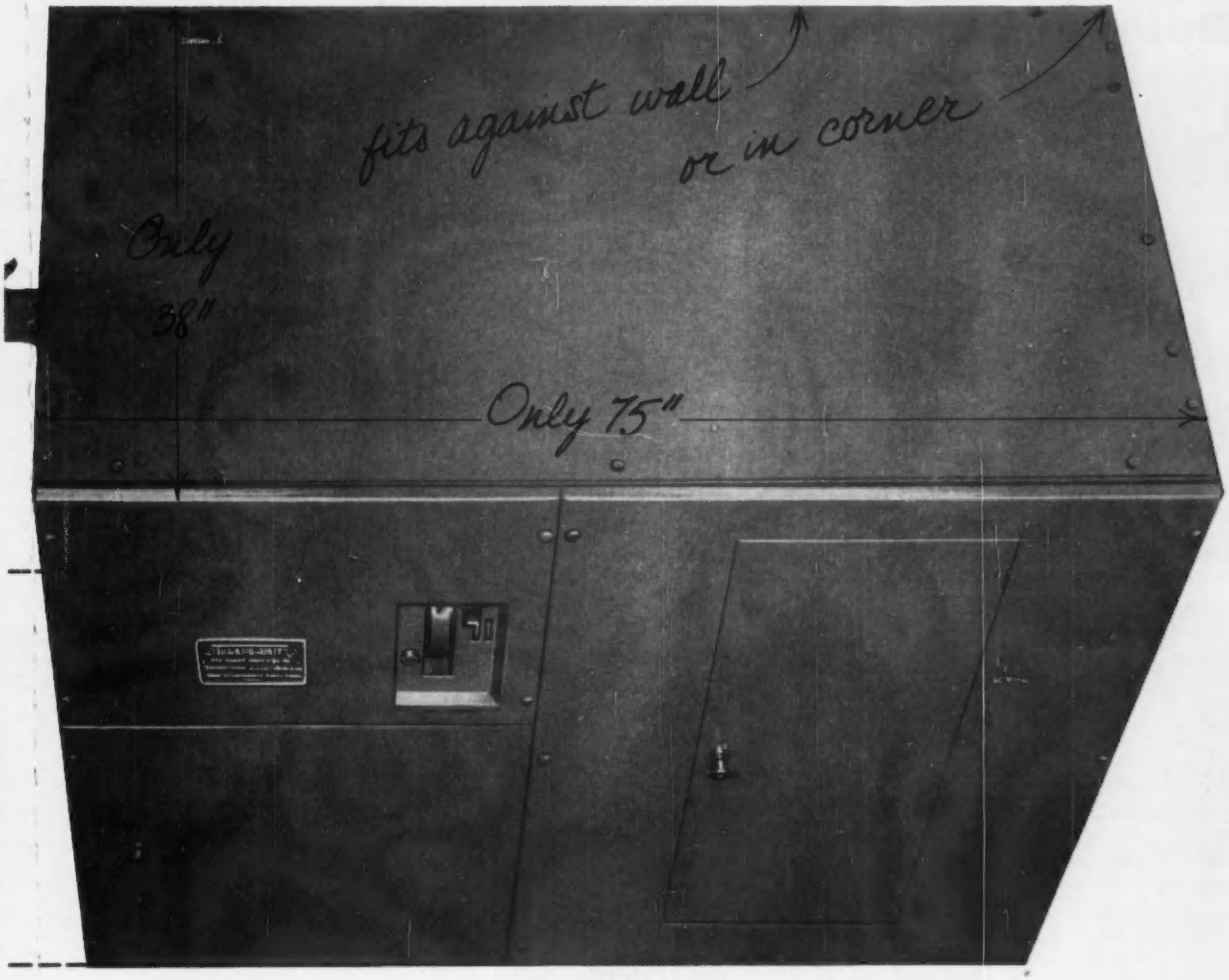
National Electric Coil

COLUMBUS 16, OHIO • IN CANADA: ST. JOHNS, QUEBEC

DIVISION OF McGRAW EDISON

NEW SPACE-SAVINGEST





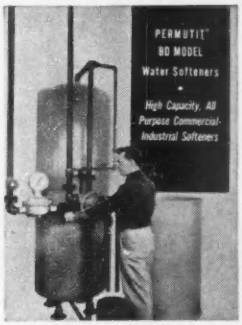
I-T-E TRANFO-UNIT®

Available in capacities up to 500 kva at 5 kv

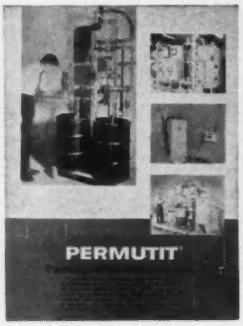
This packaged unit substation fits in places where others cannot go. In fact, it's actually the world's most compact. 20 in. lower than the old standard, 50 in. shorter. Connects from the front. So you can put it against a wall or in a corner. Dry-type transformer and a wide choice of primary and secondary devices. Send for the complete kit of information. I-T-E Circuit Breaker Company, Dept. TR, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

Build your FLUIDICS* library

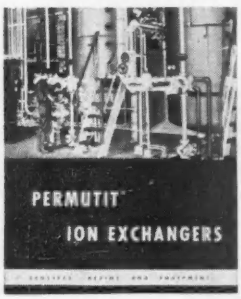


High-capacity water softening: New Permutit® Model BD Softeners answer industry's needs for more soft water at lower cost. Full details on operation, specifications and performance are contained in **Bulletin 4696.**



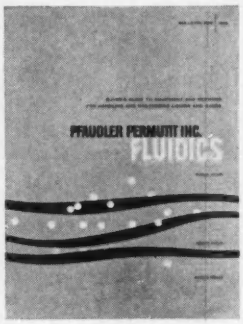
Standard packaged demineralizers: Factory-assembled, systems ready to connect and operate. For summary of applications, plus data on mixed-bed, two-step, non-regenerable and skid-mounted units, send for **Bulletin 4721.**

Automatic valveless gravity filter: Costs up to 45% less than conventional filters. Also saves money after installation, because it operates automatically without a single valve, agitator, pump, flow controller, or an attendant operator. **Bulletin 4351.**

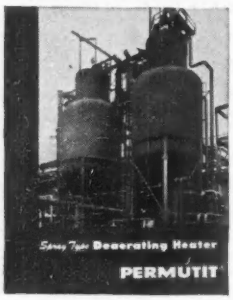


Ion exchangers: From Permutit—the only company to manufacture ion exchange resins and the equipment in which they are used—a manual on ion exchange as a unit process for purification, recovery, addition, separation, concentration. **Bulletin 2508** also covers resins and equipment.

"New" metals for processing: Tantalum, titanium and zirconium are finding increased use because of their exceptional corrosion resistance and strength. Corrosion, heat transfer and general application data on these metals, plus equipment available, see **Bulletin 978.**



How FLUIDICS works for you: Buyer's Guide surveys equipment for water and waste treatment, ion exchange, gas analysis, metering and control. Also equipment for handling corrosives, heat transfer, reactions, centrifuging and packaging. Send for **Bulletin 992.**



Deaerating Heaters: Designed for removal of carbon dioxide and oxygen from boiler feedwater. Permutit offers both Spray Deaerators, **Bulletin 2357,** and Tray Deaerators, **Bulletin 4732.**

Permutit Precipitator: Saves about 50% in ground space, 50%-75% in time of treatment, and 10%-40% in certain chemicals and adsorbents, compared to conventional reaction and settling tank. Complete facts on operation and applications are in **Bulletin 2204C.**

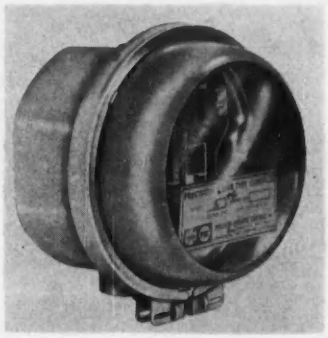
Water treatment chemicals: Permutit offers an extensive line of specialized chemicals. Typical data available: **Bulletin CS-105** on Wisprofloc-20 Coagulant Aid, **Bulletin CS-111** on Neutralizing Amines, **Bulletin CS-110** on the Briquet System.

PFAUDLER PERMUTIT INC.
Specialists in FLUIDICS . . . the science of fluid processes

WRITE FOR FREE COPIES of any of these Bulletins. Permutit Division, Dept. EW-110, 50 West 44th Street, New York 36, New York.

Smoke Recorder . . .

. . . has adjustable sensitivity that can be set to cover a desired range of smoke spectrum, from clear to blackout or a part of the range. The Photomation smoke recorder, a null-balance potentiometer, can also be used with charts with Ringelmann numbers. It is for new boilers or older ones being modernized.
Photomation, Inc, 96 S Washington Ave, Bergenfield, N. J.



Lighting Control . . .

. . . in a meter-type housing weighs less than 2 lb. The two-component tubeless control operates in ambients of —40F to 170F. It is mounted on a standard watthour-meter base plate and is enclosed in a shallow glass housing. It is available for various foot-candle levels, supply voltages and load ratings.
Precision Multiple Controls, Inc, 233 Chestnut, Ridgewood, N. J.

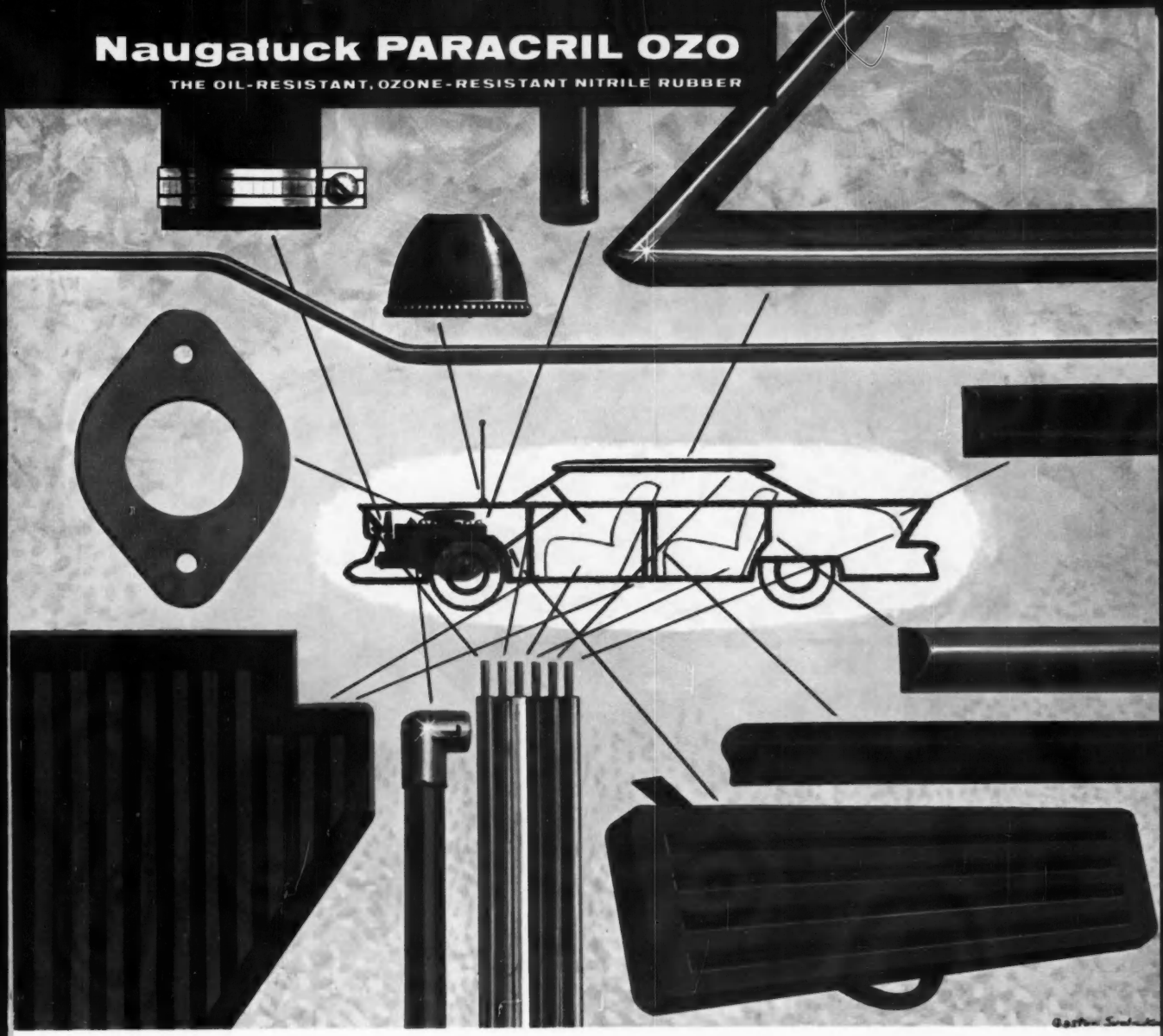
More New Products

Rigid plastic **electrical conduits** of PVC, with light or heavy walls, can be installed above or underground. Types made from modified styrene are for underground encasement in concrete or direct burial.—Wheatland Electric Products Co, 500 Logan St, Carnegie, Pa.

Dual-element **cartridge fuses** for 250 and 600 v blow fast on short circuits but provide time-delay operation to prevent blowing on short-time overloads.—Monarch Electric Div, El-Tronics, Inc, Jamestown, N. Y.

Naugatuck PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER



Great new advance in automotive rubber

Here is a new rubber that's unmatched for oil, weather, and abrasion resistance. It's new PARACRIL® OZO, the finest achievement yet in the nitrile rubber field. PARACRIL OZO's properties are tailor made for many modern automotive parts—for everything from weather stripping to oil seals and hose. PARACRIL OZO gives you a whole series of important advantages, including:

- significantly superior ozone resistance
- excellent fuel and oil resistance
- several times greater abrasion resistance
- permanent retention of bright colors for exterior styling and easily traceable wiring and other interior parts

Look into PARACRIL OZO. Discover for yourself its new design possibilities...its unlimited color...its high quality. Contact your nearest Naugatuck representative at the address below.

Naugatuck Chemical

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how does 1970 look... from here?

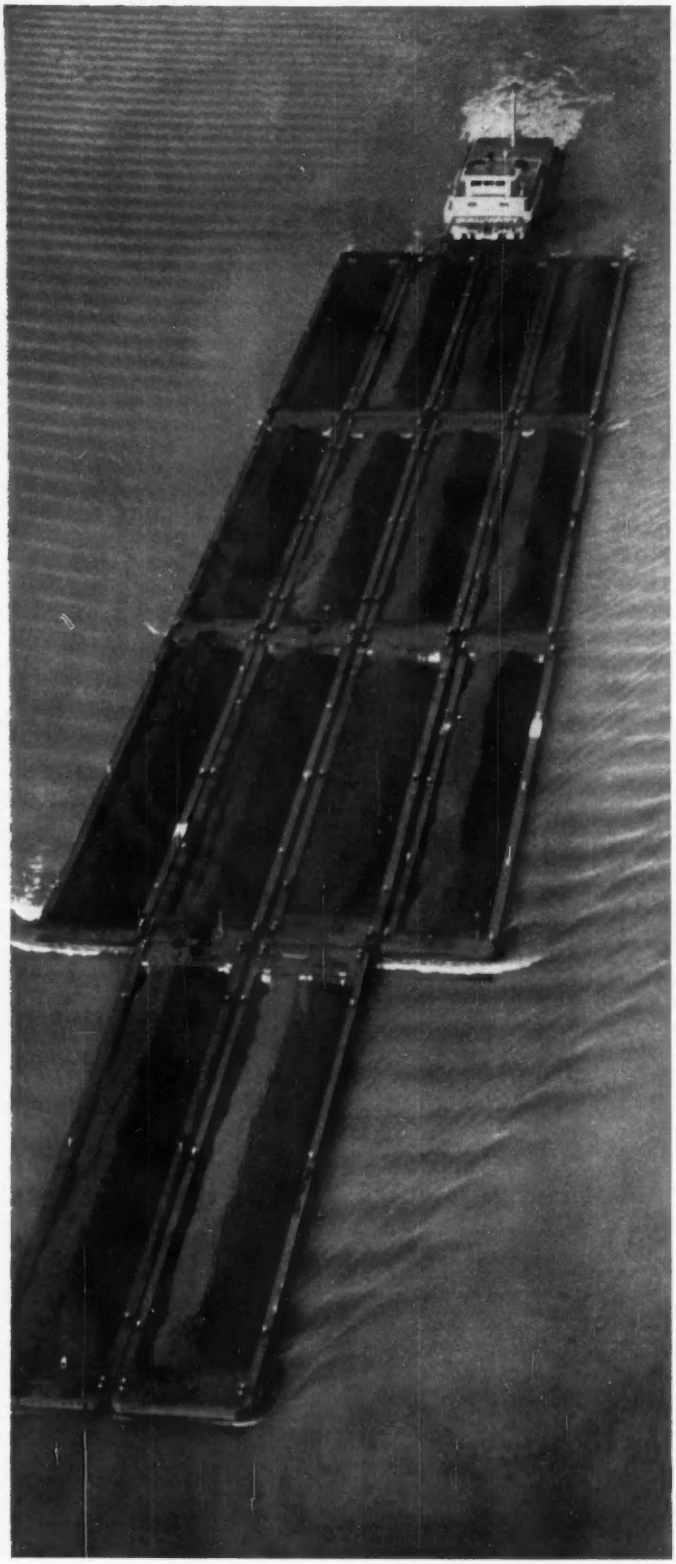
(and how about 1980?)

The most look-ahead industry in the nation is undoubtedly the electric utilities. Glance back over the past 10 years and the reason is obvious. And with even greater electric needs forecast for the next 10 and 20 years, it's not surprising that any remaining short-term thinking about the way to buy *coal* is giving way rapidly to the same *long look ahead.*

There is increasing awareness that behind an attractive invoice price can be the hidden incremental costs of excessive coal handling, ash handling, equipment outages, freight charges on inerts, operating inefficiencies of many kinds.

There is increasing interest in quality coal that delivers *steam* at the lowest *net* cost. There is increasing interest in adequate reserves, in uniformity of supply, in suppliers in a position to deliver the right kind of coal on a reassuring long-term contract basis.

An increasing number of utilities are looking to Island Creek as a supplier of such coal . . . and such reassurance. We'd welcome a chance to discuss this matter more specifically with you. Write, wire or phone.



You can depend on Island Creek . . . a career company dedicated to coal

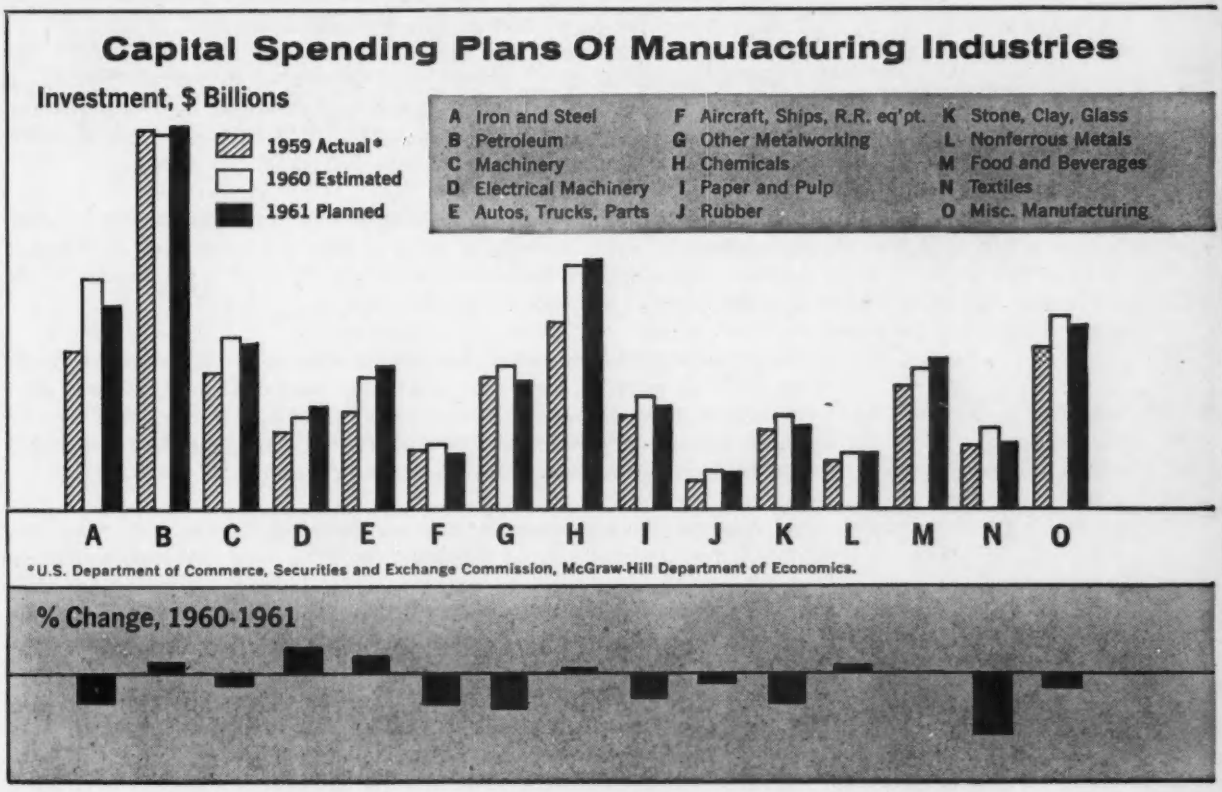
ISLAND CREEK Precisioneered Coals

ISLAND CREEK COAL SALES COMPANY, Chafin Building, Huntington 18, West Virginia • Chicago • Cincinnati • Cleveland • Detroit • Greensboro • New York • Pittsburgh

Electrical World

NOVEMBER 21, 1960

Management Newsletter


Capital Spending Plans Of Manufacturing Industries
Investment, $ Billions
1959 Actual*
1960 Estimated
1961 Planned
A Iron and Steel
B Petroleum
C Machinery
D Electrical Machinery
E Autos, Trucks, Parts
F Aircraft, Ships, R.R. eq'pt.
G Other Metalworking
H Chemicals
I Paper and Pulp
J Rubber
K Stone, Clay, Glass
L Nonferrous Metals
M Food and Beverages
N Textiles
O Misc. Manufacturing
A B C D E F G H I J K L M N O
*U.S. Department of Commerce, Securities and Exchange Commission, McGraw-Hill Department of Economics.
% Change, 1960-1961

Capital Spending Faces Slight Dip in 1961

A good but not spectacular outlay for new plant and equipment seems in prospect for 1961. US business now plans to spend slightly less for new plant and equipment than in 1960, but still considerably more than in 1959, according to a survey just completed by the McGraw-Hill Department of Economics. For manufacturing industries, a comparable cut is in the offing, but with a little fatter margin over 1959 spending. Here are some of the highlights of the survey:

- **American business as a whole will spend about $35.1 billion** on new plants and equipment in 1961—down about 3% from indicated 1960 spending but still a good $2.52 billion (7.7%) above 1959. And preliminary plans for 1962 indicate a spending level close to that for 1961.
- **Manufacturing companies will trim investment about 3%** below that estimated for 1960, down to about $14 billion. And these companies already have preliminary plans to spend a comparable amount in 1962.
- **No let-up is in sight for the rising investment by electric and gas utilities,** currently planning an investment that will top this year's by approximately 4%.
- **Except for transportation equipment,** every major manufacturing industry antici-

pates a rise in sales next year, with an overall average of about 3%.
• **And these are plans made when the average operating rate** for all manufacturing industry was only 79% of capacity, well below the 94% average preferred rate.

Keep in mind that this survey is not a forecast—only a report of business' plans as of October, the budget-making time for many companies. So it represents only preliminary thinking based on current business conditions and prophecies for the year ahead. And this year, because of uncertainties in the general economy, some of these plans are relatively tentative.

Actual spending next year will depend on the fate of the general economy, the profit picture, and government policy—especially government policy. For not only does it affect cost of money, both to industry and consumer (and with a new administration about to take over, there is much uncertainty here). It also exerts a great deal of leverage on regulated industries, on industries where tariffs, import quotas and the like have a major effect on markets, and on industries that sell a significant part of their product to the government.

So this high level of investment in 1961 could be a strong prop for the economy, especially in a period of declining profit margins and a slowdown in industrial activity. And of course, this investment will be reflected in the business of the men who supply the capital equipment suppliers.

But with a gray business outlook and low operating rates, why are capital spending plans so relatively high? For one thing, many industries have not spent as much as they planned for new production facilities this year. Well over $1 billion has been trimmed from 1960 capital spending plans since last spring. But much of this has only been postponed, not cut out of the budget.

Moreover, despite excess capacity and low operating rates in many industries, there is a strong push and justification for further or even wide-scale modernization in American industry. In fact, the excess capacity and the intense competition it breeds are stimulating modernization. So are rising foreign competition and the prospect of further increases in labor costs. And though inventories are heavy in some industries, they are not the overburdening load they were in late 1957. Moreover, the consumer savings rate is the highest in two years, piling up cash that could be used to step up purchases on short notice.

Generally, non-manufacturing industries are the slow growers on next year's capital investment list—excluding, of course, utilities. The railroad industry, which spent over $1 billion this year, now looks for a 24% cut in capital outlay in 1961. Air lines, buses, shipping and trucking, who have completed most of their modernization this year, are planning a stiff cut, averaging about 11%. Mining investment is also expected to drop again, in addition to the pruning already done in this year's capital investment.

In fact, the commercial segment of the non-manufacturing group is the utilities sole partner in boosting 1961 outlays. (In the McGraw-Hill survey, this segment includes only large banks, insurance companies, large chain, mail order, and department stores.) The 1% increase anticipated here reflects continued office building, as well as spending for computers, business autos, and trucks.

What about the outlook for the individual manufacturing industries? Most plan to spend a little less next year, as shown by the chart on page 125. But not the electrical machinery industry. Biggest trend-bucker on the list, it is talking in terms of a 10% boost over this year's expected outlay. Why the high investment rate when there is so much talk of excess capacity? Simply because, it too has lots of room to modernize some of its capacity to improve production efficiency. Moreover, the industry will spend considerably less this year than it originally planned and apparently is pushing some of this over into next year.

HERE'S HOW PRESENT PLANS FOR '61 CAPITAL SPENDING LOOK

(Billions of Dollars)

INDUSTRY	1959 Actual *	1960 Estimated	1961 Planned	1960-1961 % Change	1962 Planned
ALL MANUFACTURING	$12.07	$14.33	$13.93	−3%	$13.35
Mining	.99	.99	.90	−9	.89
Railroads	.92	1.04	.79	−24	.83
Other Transportation & Communications	4.69	5.20	4.61	−11	4.18
Electric and Gas Utilities	5.67	5.89	6.14	+4	6.01
Commercial †	8.21	8.61	8.70	+1	8.54
ALL BUSINESS	32.55	36.06	35.07	−3	33.80

* U.S. Department of Commerce, Securities and Exchange Commission, and McGraw-Hill Department of Economics.
† Figure based on large chain, mail order and department stores, insurance companies, banks and other commercial businesses.

Further boosts are in store in the auto (7%), food and beverages (5%), petroleum (3%) and chemical (2%) industries. Although auto makers don't expect next year to be as good as 1960, neither do they see anything as bad as 1958. And 1961 spending plans have actually risen since last spring. Of course, the auto industry's operating rate, even in the month before model changeover, was in considerably better shape than most other industries.

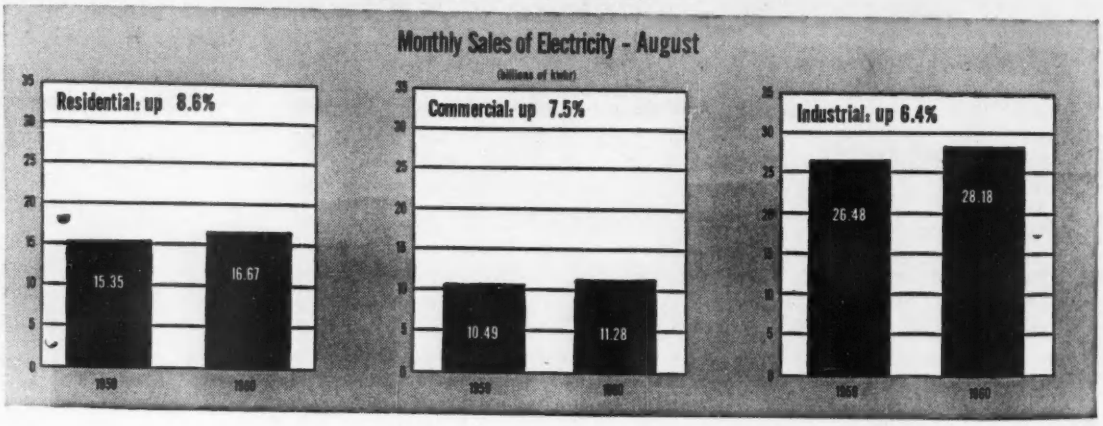
By contrast, the petroleum processers, though planning more spending next year, were operating nearly 15% below their preferred rate as of September. But oil men are by tradition optimistic. And third quarter earnings showed a definite improvement. Moreover, industry insiders expect much of this investment to go into modernization—where oil has long been a leader—with little increase in crude capacity.

No hiatus is in prospect for the chemical industry's long term growth. Like the petroleum industry, it has long been one of the most cost conscious (and heaviest power users) of all industries, quick to pick up any technique that promises realistic productivity gains. Thus, despite a September operating rate some 17% below preferred, it expects to lay out even more money next year than the whopping $1.61 billion anticipated for 1960. And again, most of this will go for plant modernization, with some additional capacity for new products rolling out of its formidable array of research and development laboratories.

But even in most of the "cut-back" industries, the outlook is not completely gloomy. Only two industries in the list—transportation and other metal working —are planning to invest less than in 1959. And many industries, notably the machinery, paper and pulp, food and beverages, and miscellaneous group have jacked up their 1961 spending plans since early this year.

Nor will a low operating rate keep the steel industry from registering its third highest outlay on record—in spite of a 10% cutback from 1960 level—to rack up a healthy $1.37 billion investment. Again, the impetus is modernization, the need to upgrade obsolete facilities, particularly with heavy competition from overseas producers and from other materials (plastics, non-ferrous metals, and concrete) domestically.

Even the proverbially slow moving textile industry, the biggest belt-tightener on next year's list, will end up ahead of 1959. And the 21% cut projected for next year loses much of its pain in the light of the 30% increase from 1959 to 1960, a tough growth record for almost any industry to maintain. Like most other industries, textiles will put most of its dollars into modernization, little or none into new capacity.



Power Statistics

		Latest Month	Year Ago	Annual Change %
Capacity	Aug.	164.28	153.67	6.9
Dec. '59 Peak (million kw)		121.6	113.5	7.2
Est. Dec. '60 Peak	Aug.	133.7	134.3	−0.4
Production—billion kwhr	Aug.	67.26	63.08	6.6
Hydro		12.12	10.96	10.6
Fuel		55.14	52.12	5.8
Sales—billion kwhr	Aug.	59.80	55.65	7.5
Residential		16.67	15.35	8.6
Commercial		11.28	10.49	7.5
Industrial		28.18	26.48	6.4
Other		3.67	3.33	10.2
Fuel Consumption	Aug.			
Coal—million tons		14.92	14.02	6.4
Oil—million barrels		6.10	6.31	−3.3
Gas—billion cu ft		195.45	191.44	2.1
Net Income Class A & B Co's—$ million	Aug.	137.24	129.88	5.7
Residential Customers—millions	12 mos.	49.54	48.37	2.4
Revenue per kwhr	ended	2.48¢	2.52¢	−1.6
Avg kwhr per customer	July 31*	3,730	3,470	7.5
Avg annual bill		$92.50	$87.44	5.8

Business Statistics

Indexes: 1947–49 = 100				
FRB Industrial Production	Sept.	164	159	3.1
ENR Construction Cost	Nov.	174.0	169.8	2.5
BLS Cost-of-living	Sept.	126.8	125.2	1.3
New Orders for Machinery (1950 = 100)	Sept.	167	167	——
NEMA Sales				
Insulation materials	Aug.	131	145	−10
†Electric appliances (1956 = 100)		81.7	90.8	−10.1
Wholesale prices				
Motors and generators	Aug.	141.3	145.1	−2.6
Transformers and regulators		141.9	149.7	−5.2
Switchgear and fuses		173.4	178.7	−3.0
GNP—annual rate—$ billion	2nd qtr.	497.4	484.5	2.7

* Latest figures available from EEI. † NEMA Index of Net Sales Billed of Consumer products (1956=100) replaces Major Appliance Index (1947–1949=100).

WESTINGHOUSE POWERCASTING* predicts super-capacity plants...demanding automatic operation

Load growth is accelerating. To meet demands, utilities will continue to add generation capacity in ever larger units. Accompanying the super-capacity of equipment is its increasing complexity, far greater instrumentation, mounting need for reliability.

To control this massive, and expensive, facility efficiently or even adequately is fast approaching the limits of human ability. Emergency conditions bring the problem into critical focus. Operating variables throughout a typical station number in the hundreds. It is virtually impossible for personnel to assimilate all necessary data, to analyze and translate it quickly into the best course of action. Hurried decisions based on hasty scanning of complex interrelationships by operators under great stress make the possibility of major equipment damage a constant threat. Records indicate that chances are one in three a major accident will occur in the lifetime of your plant.

The cost of a single major outage due to operator error can easily exceed the total cost of a completely automatic control system. The automatic steam plant is coming because it must . . . to make your huge capital investment in generation operationally economical, reliable, safe for men and equipment.

*A Service-Mark of Westinghouse

Westinghouse

WESTINGHOUSE POWERCASTING*

Westinghouse program of product development concentrates on automatic power plant

Prodac† means PROgrammed Digital Automatic Control. It is a high-speed computer designed specifically for steam station system control. Here are just a few of the unique services Prodac can perform for you.

Special logic unit and priority director simplify and expedite the making of thousands of decisions required for sequencing and control of a generating unit. Sequencing changes are made automatically whenever needed to start up, shut down or run at maximum efficiency under either normal or emergency conditions.

Prodac rapidly and continually scans and logs all necessary system variables, keeps up-to-the-minute records. By extensive calculations, this information is presented in meaningful heat rates and unit efficiencies. After analysis, required changes are made automatically to optimize performance of the entire plant.

All sub-loop control systems for the turbine-generator, boiler, fuel, feedwater, and all other plant systems are completely coordinated and integrated in Prodac.

Plant reliability is greatly improved with special stored programs with which Prodac can at any time take high-speed corrective action, under both normal and emergency conditions. Operator error has been designed out.

Availability of each turbine unit is significantly increased by reducing start-up time, cutting down time. Maintenance is cut appreciably . . . plant equipment limits are not exceeded.

Manpower requirements are reduced because of the computer's ability to observe and interpret large

quantities of data, and to perform a multitude of control functions . . . unattended.

Because of Prodac's high speed, immense capacity and many exclusive functions, these and other rewards are available to you from Westinghouse.

Turbine and generator section

New sub-loop controls equip Westinghouse turbine-generators for automation.

These new devices and subcontrol loops are necessary to adapt the turbine-generator for control by digital computer.

A wide-speed range governor, utilizing a magnetic pickup and static control equipment, has been developed for use during turbine-generator start-up. It controls shaft speed to the value dictated by the computer start-up program.

The automatic turning gear automatically engages the gear and starts the motor when the rotor comes to rest. The "at rest" condition is detected by a hydraulic zero speed indicating device.

The lube oil, seal oil and hydrogen systems are equipped for complete automatic operation.

A capability curve regulator has been developed to assure that the generator always operates within the capability curve of the generator.

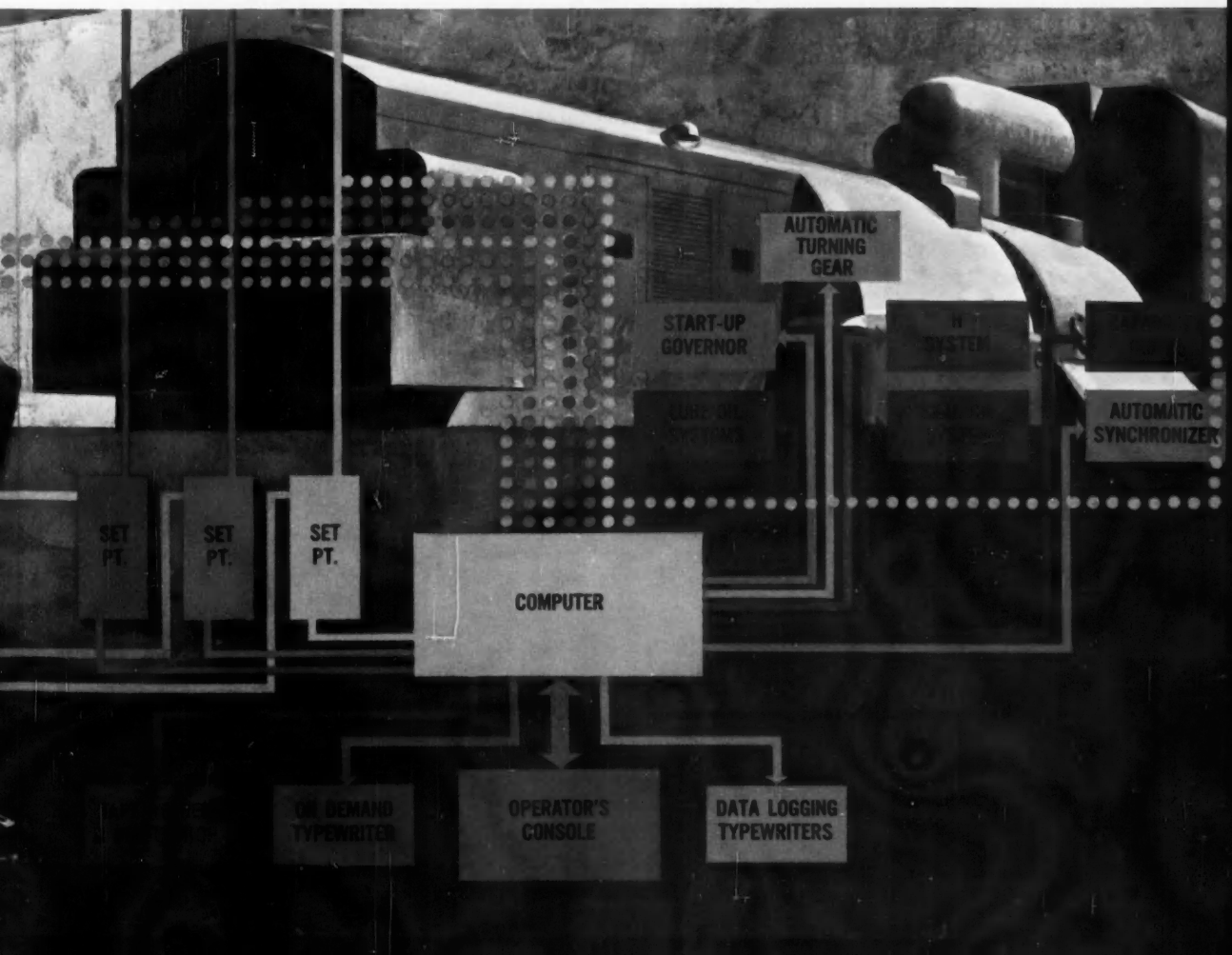
Westinghouse Powercasting can help you plan your system's future

Today, some utilities are faced with the immediate prospect of purchasing an automatic plant. You may be one of them. Whether or not you can make a decision now or any time may depend heavily upon the predictive and planning techniques available to you.

Westinghouse has developed a fundamentally new technique of total system planning . . . Powercasting. With the growing complexity of today's utility system, conventional planning methods just won't provide the answers fully or precisely enough. Therefore, Powercasting offers you a new way to create a plan, together with total capital investment needs, projected for the next 20 years.

•A Service-Mark of Westinghouse
†Trade-Mark

Westinghouse



Public Service with Westinghouse to automate its largest generating unit

Electric utility seeks today's ultimate in reliability—Westinghouse will engineer, furnish and coordinate the computer for automatic control on the Sewaren Generating Station Unit No. 5 for Public Service Electric and Gas Company of New Jersey. On-line target date—early 1962. On order—a 342,000-kw cross-compound turbine-generator and the new Prodac computer-control system.

This new unit will be more reliable than any conventionally controlled plant. Computer-control will provide greater reliability because it permits careful pre-programming of all normal and emergency operating procedures—precise, rapid supervision of incoming signals from hundreds of sensitive detectors—nearly instantaneous, multiple control of all critical power plant apparatus—anticipation and prediction of critical events before they occur, in time for corrective action.

The Westinghouse Prodac to be installed is the first industrial process computer-control using the unique new priority director to simplify the program, increase the operating speed and more efficiently utilize the memory capacity.

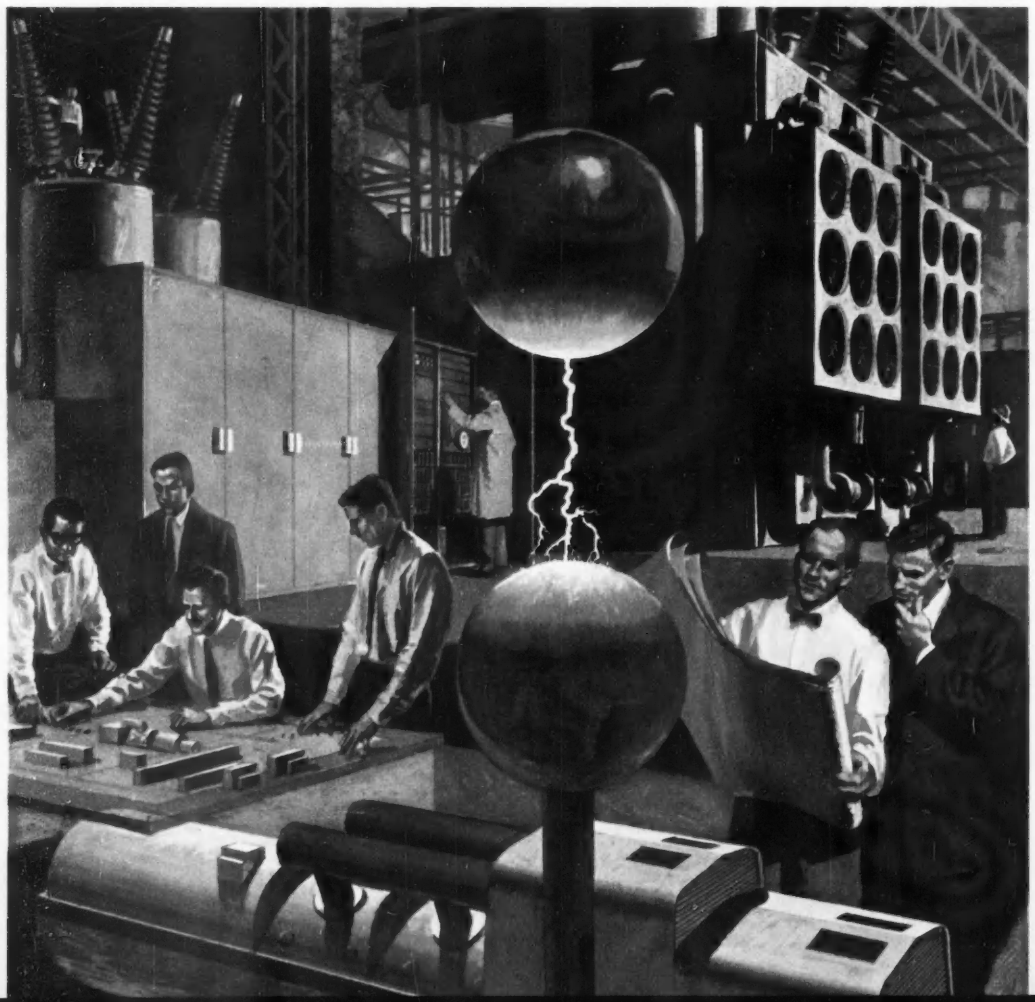
Westinghouse experience in the special problems and objectives of the electric utility industry is broad and deep. The men in Westinghouse, having this important experience capability, will use the most advanced analytical engineering and research facilities to help Public Service be certain that all aspects of this important project have been properly coordinated.

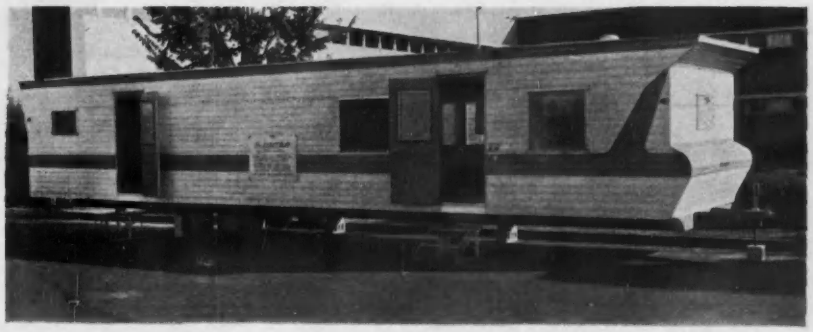
You can be sure . . . if it's Westinghouse.

Westinghouse

CP-1059

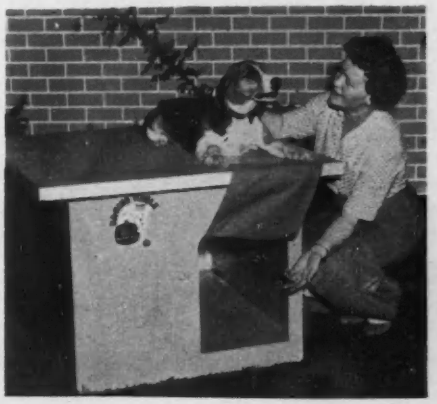
Litho in U.S.A.





MOBILE HOME has electric heat, water heating and cooking equipment. Home on wheels has been awarded the Gold Medallion

EVEN DOGS can now live better electrically. This dog house is electrically heated and was marked 'sold' 15 minutes after it went on view at the show



Products of the Future Increase Crowd At Electrical Exposition

Initial attendance estimate was 20,000 and most exhibitors expected nothing more than the usual product and company exposure.

Both estimates were wrong.

Over 35,000 people attended and the exhibitors collected 3,000 qualified leads and bona fide orders for $100,000 of electrical merchandise and complete electric heating installations. There's no telling how many other orders they got after the show.

This was the before and after story of the recent Electarama, an all-electric show sponsored by the Electrical Assn of Reading and Berks County, Pa., with the cooperation of the local utility, Metropolitan Edison Co, electrical dealers, distributors and manufacturers.

In four days the 35,000 viewers saw new product developments and working models of futuristic equipment, worked electronic and ultrasonic appliances, saw the latest in heating and cooling equipment, and witnessed "live" demonstrations.

Some of the highlights:

- Many people got their first ride in an electric automobile
- A display of atomic power at work, direct from the Oak Ridge Nuclear Institute
- An electrically heated dog house ("a real attention getter," according to the show planners)
- A demonstration, "Light Sorcery," which portrayed the developments of light from Edison to today, and research developments for future uses in home and business
- A motorcade through downtown Reading comprised of 60 vehicles owned by local electrical dealers and the utility's two electric automobiles
- Visitors saw themselves on closed circuit TV upon entering the show
- Local lending agencies explained their personal loan plans available for electric improvements, appliances and house heating
- Demonstrations of electric outdoor living—electric patio carts, color lighting, protective lighting, electric water fountains, and infrared heating equipment.

The electric automobiles seemed to attract the most interest. The two questions most asked: When is it going to be marketed? Through whom will it be sold—automobile or appliance dealers? Many people commented on the "no noise" feature.

On the card visitors filled out to be eligible for door prizes, the question was asked, which exhibit intrigued them the most? The majority answer: the electric automobile.

The largest show ever held in the Reading area, it was promoted through newspaper advertisements, radio and TV, and free admission tickets were distributed to civic and trade groups.

Regular radio broadcasts—interview-type shows—were made direct

(*Continued on page* 136)

Good fabrication and welding properties of "T-1" Steel saved time and money in the shop and on location. Owner: The Washington Water Power Company. Engineering: Ebasco Services, Inc. Scroll cases: Chicago Bridge & Iron Co. Turbines: Allis-Chalmers Co. General contractor: Morrisor-Knudsen Co.

"T-1" Steel cuts weight of big turbine scroll cases 50%

A SCROLL CASE looks like a giant sea shell. Water gushes into it from a high level reservoir. Through the conch, the water swirls in an ever-tightening spiral into the blades of water turbines. Because the cross section of the spiral passage diminishes, the water pressure and velocities are built up for efficient power generation. Four of these scroll cases, among the largest in the United States, have been built from USS "T-1" Steel by the Chicago Bridge & Iron Company. They are installed in the Noxon Rapids Dam, an $87 million project now under construction by the Washington Water Power Company to harness the waters of Clark Fork River. The dam is located on the site of a prehistoric lake in western Montana.

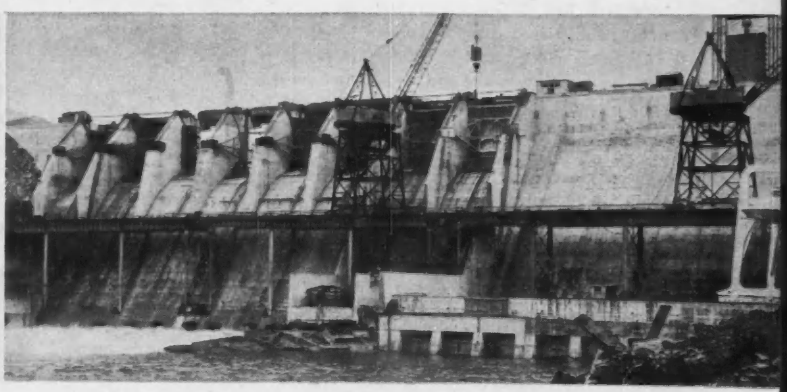
Because of the fierce pressure and erosive action of the water, it was obvious that a very strong, abrasion-resisting steel was required. USS "T-1" Constructional Alloy Steel not only met these requirements, but permitted a reduction of about 50% in plate thickness.

COST SAVINGS. By using USS "T-1" Steel, there was substantially less weight of material to ship across the country. Weld time and weld metal were reduced. Foundations could be made smaller.

This job points up the economies possible with the use of USS "T-1" Steel: lighter weight, greater strength, weldability and resistance to impact abrasion. Write for our "T-1" Steel book containing complete information. United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

USS and "T-1" are registered trademarks

Scroll cases built with USS "T-1" Steel to obtain maximum strength with the least weight. Largest diameter is 24 feet with a speed ring about 28 feet in diameter.



Noxon Rapids Dam a new $87,000,000 power project by the Washington Water Power Company to harness the waters of Clark Fork River in western Montana.

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

(*Continued from page* 133)

from the exposition. Two Philadelphia TV stations included the show on their news broadcasts.

Special attendance prize was "free electricity for a whole year," with the electric association paying the bill. The winner's 1959 bill was checked and this amount was credited to his account. Other door prizes included electric wrist watches, radios, shavers, and electrical merchandise gift certificates.

Special bus loads of school children in science, home economics and industrial vocational courses, attended as a classroom function. Civic clubs also came in groups.

Every major electrical equipment manufacturer participated.

Visitors came from New York, Maryland, New Jersey, Delaware and other Mid-Atlantic states.

A keen interest was seen in electric heating. Met Ed exhibited many case histories and user testimonials. Electric heat exhibitors were asked by many visitors for estimates on new and old homes.

One dealer said, "I received more good leads during this show than I did in all my three years of business put together."

Another retailer had only sold one refrigerator in seven months. Yet he sold four the first day of the show.

Although the show was a tremendous success, according to G. E. Parks of the electrical association, to make the idea meaningful, the show will not be an every year occurrence.

"When there are enough new items to be shown we will have another show. Only in that way will the people come," he said.

SMUD Campaign to Guarantee Heating Costs

Guaranteed heating costs will be the key feature of the electric comfort heating campaign now being planned by Sacramento Municipal Utility District. It will be the first electric heating campaign ever conducted by the utility.

The promotion is based on the proposal that the cost of electric heating in the average house of 1,300 sq ft should not exceed $87 per year. This is contingent upon the house being properly insulated and the heating system properly designed.

Individual estimates of heating costs will be given and if the heating bill exceeds the estimates for a three-year period, the Sacramento Valley Electric League, a SMUD-sponsored organization, will pay one-half the amount over the estimate.

An incentive program will be offered to electrical contractors. Participating manufacturers will cooperate in defraying the cost of the program.

Also, a training program for contractors in sizing, installing and estimating operating costs of electric heating will be provided.

Latest Industrial Lighting Techniques Explored

The latest techniques in industrial lighting were explained to over 600 architects, engineers and plant managers at the 1960 Industrial Lighting Clinic and Conference.

Sponsored by Consolidated Edison Co of New York Inc, 14 electrical manufacturers presented lighting demonstrations, displays and exhibits. Demonstrations included how to use mercury, incandescent, and fluorescent lighting for general lighting, close seeing tasks, and many special applications in factories.

E. A. Lindsay, General Electric Co, noted the tremendous strides taken by industrial lighting in the past five years. "Much of the lighting accepted five to ten years ago is now obsolete," he said. Whereas 50 footcandles was acceptable in 1950, today it is 100. "At the same time, the cost of light has gone down. In 1906, one ft-c cost about 7.7% of the average worker's salary. Today, 200 ft-c cost 3.4% of the worker's wages," he commented.

"The fastest growing element in the light source field is the color-corrected mercury lamp," according to Marshall Waterman, Westinghouse Electric Corp.

George Clark, factory lighting expert for Sylvania Electric Products Inc, predicted: Lighting equipment will lose its identity as being either commercial or industrial; there will be more and more integration of lighting with environmental elements —sound, color, air conditioning, etc.; and there will be further investigation of the pyschological impact of good visual conditions.

PUAA Sets Better Copy Contest Deadlines

The Public Utilities Advertising Assn's 38th annual Better Copy Contest has set its deadline for entries as Feb. 1, 1961. The annual report deadline, however, is April 1.

W. L. Perdue, 1961 contest chairman, said the 1961 competition has 20 individual classifications, including those on direct mail, employee magazines, newspaper advertisements, radio and television activities, motion pictures, and car cards.

The contest is open to any business-managed utility, whether or not it is a member of PUAA.

Member companies will receive copies of the 1961 rules early next month. Other companies may obtain information from: W. L. Perdue, Kansas Power & Light Co, 800 Kansas Ave, Topeka, Kansas.

Largest All-Electric Apartment House Going Up

What may be the nation's largest all-electric apartment house is being constructed on the West Coast.

The Park Westwood Tower, now under construction in West Los Angeles, Calif., will have all units equipped with electric heating, air conditioning, kitchen and laundry appliances and special lighting.

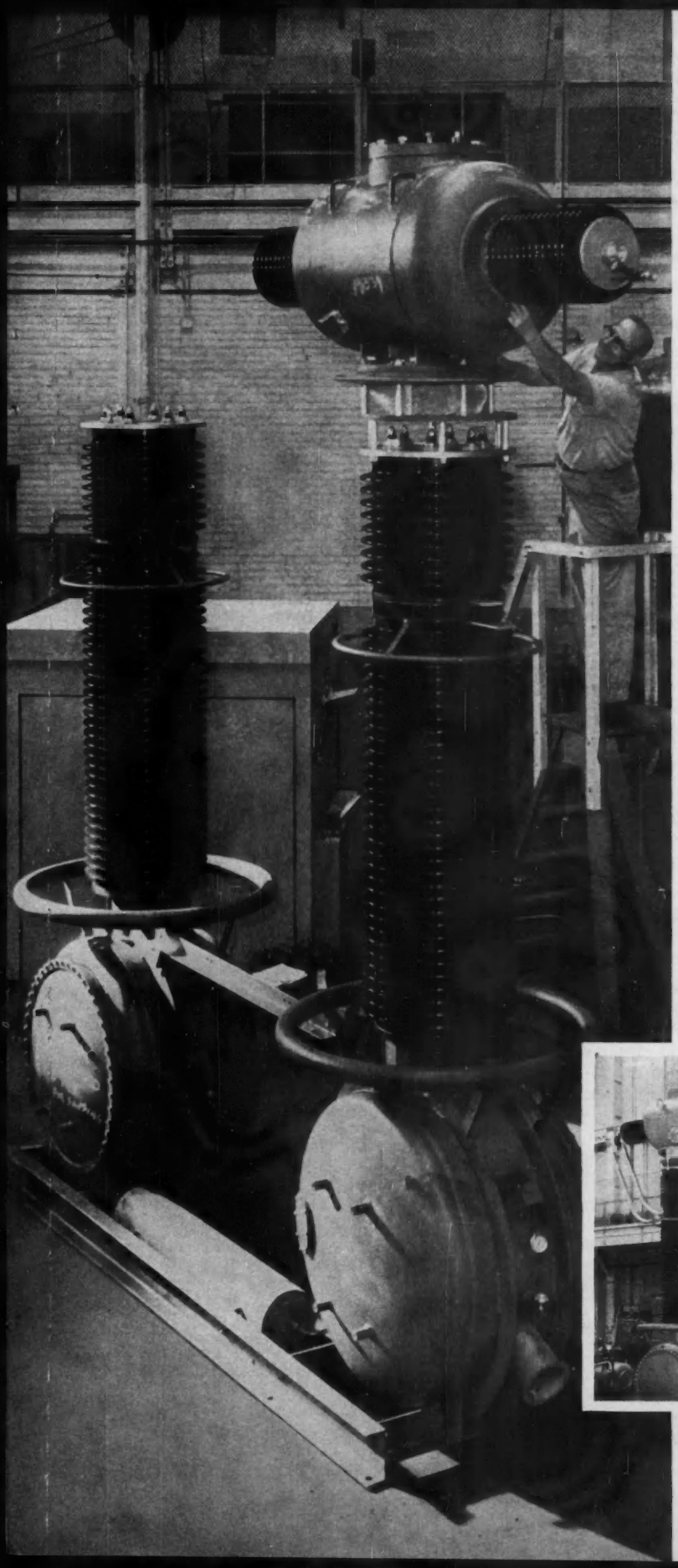
Nashville Bus Riders Expect Warm Winter

Nashville, Tenn., bus riders won't mind being kept waiting for a bus next winter.

Nashville Electric Service is installing infra-red heaters in bus shelter roofs.

Automatic controls will cut the units on at one-third capacity when the temperature drops below 50 deg, and will put out full heat at 40 deg.

The heaters and installation will cost the city about $12,000, with the heating bill estimated at $3,000.



WITH GENERAL ELECTRIC AIR-BLAST BREAKERS, YOU GET...

Protection for Supervoltages, Plus Fast Installation and Easy Maintenance

Proven in service, General Electric ATB air-blast circuit breakers are easy to install and maintain, and provide practical protection for transmission systems 115 to 460 kilovolts and higher.

Supervoltage protection is provided by the equipment's modular design, which permits ratings above 115 kv to be built by adding interrupter heads in series.

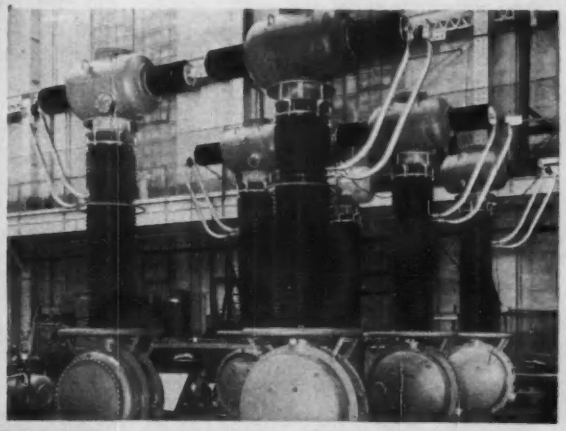
Installation is easy, because components are shipped complete, ready to be bolted in place, and because G-E air-blast breakers are up to 50% lighter than comparable oil units. Interrupters weigh less per kva than any others.

Maintenance is needed only one-third as often as for conventional oil breakers, and can be completed in one-fourth the time, because of shorter arc duration and easy accessibility of operating parts.

Ask your G-E sales engineer for more information. Or write to Section 494-04, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



GENERAL ELECTRIC'S EXPERIENCE in building air-blast breakers is your assurance of superior performance. Breakers above, rated 230 kv, are being readied for shipment.

Wine Elected VP of CP&L

CHESTER C. WINE ▶

Chester C. Wine has been elected vice president of Central Power & Light Co.

A district manager for CP&L since 1948, Wine, as a vice president, will supervise industrial development and sales.

He has had more than 32 years of service with the utility. He was named local manager in Laredo in 1942, and has served as district manager for that area since 1948. He joined CP&L as a student engineer in 1927 and later served as chief clerk in the company's Laredo and Corpus Christi districts.

He is a registered professional engineer in the State of Texas.

◀ WILLIAM J. STEWART

Wheeling Electric Co Names Stewart a VP

William J. Stewart has succeeded Robert R. Jewell as vice president and general manager of Wheeling Electric Co. Jewell will retire November 30.

Stewart came to Wheeling Electric from Ohio Power Co, both companies members of the American Electric Power System, where he started as a meter tester in Tiffin in 1925. He rose through the positions of chief radio engineer, district manager, division superintendent, executive assistant to the vice president and general manager, and assistant manager of Ohio Power's southern division.

In 1954 he was transferred to Wheeling Electric as assistant general manager.

Elston, Howard Made General Managers; Saupe to Retire

General Electric Co has named Charles W. Elston general manager of the large steam turbine-generator department, and Alan Howard, general manager of the gas turbine department. Elston succeeds W. E. Saupe who will retire at the end of the year but will continue in a consulting and advisory capacity until that time.

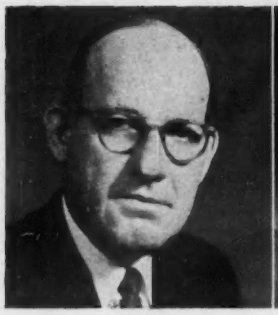
Elston joined GE in 1937 in the engineering test program. Twenty months later he was assigned to the turbine engineering department.

From 1937 to 1947 he performed assignments in connection with steam design, thermodynamic design of large steam turbines, power plant cycles and performance prediction.

In 1947 he was named assistant to the designing engineer in charge of large steam turbine design, and in 1949 was made manager-turbine engineering, large steam turbine-generator department.

He was made manager-engineering of the gas turbine department in 1958 and general manager in 1959.

Howard has been with GE since 1927, first in the advance course in engineering. In 1935 he joined the turbine division, and in 1946 became engineer in charge of development for all non-aircraft gas turbines.



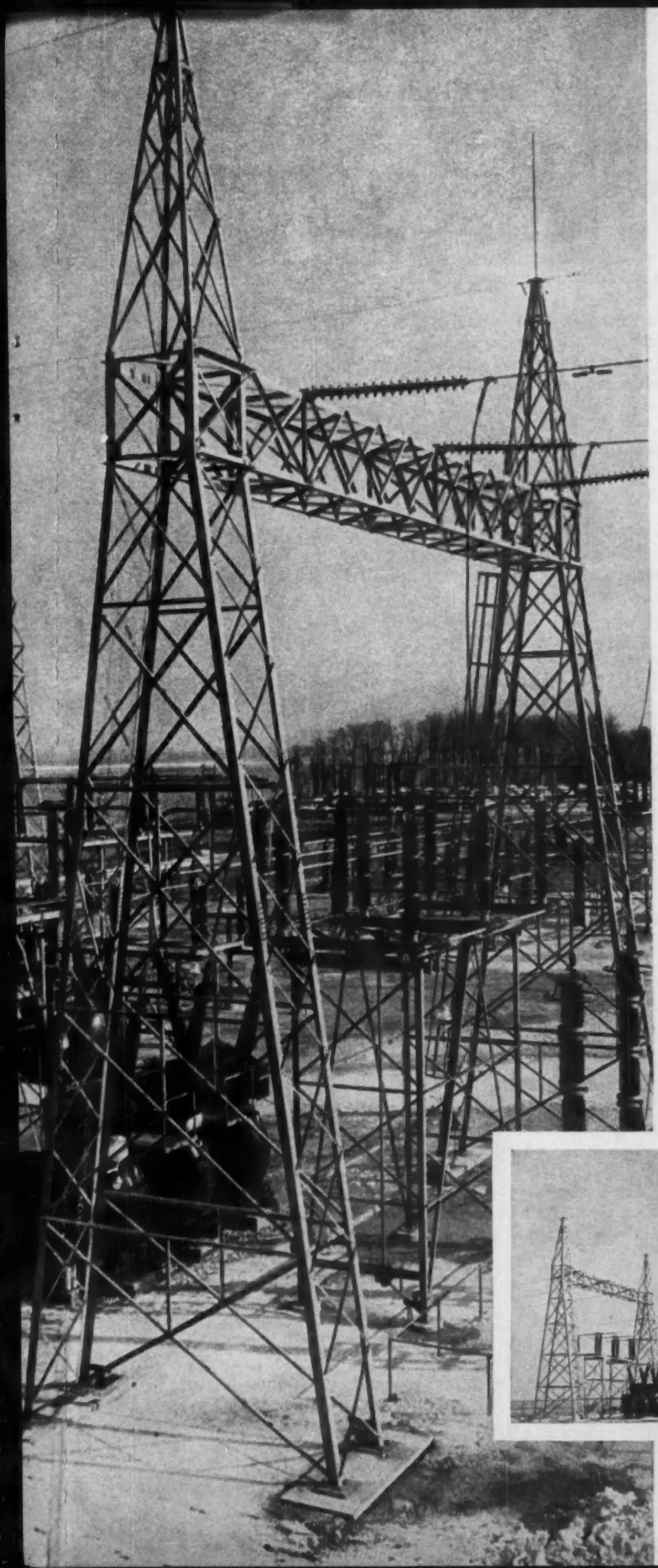
ELSTON

HOWARD

He became general manager of the gas turbine in 1951, manager of the engineering department, turbine division in 1952, and manager-engineering in the Lynn, Mass., plant in 1954.

Saupe has been with GE since 1917, and general manager of the large steam turbine-generator department since 1951.

(*More News About People on page* 140)



GENERAL ELECTRIC'S VARIETY OF STRUCTURAL DESIGNS MEAN YOU CAN...

Meet Your Exact Station Requirements, and Save Installation Time and Money

General Electric's flexible approach to the design of outdoor stations permits an almost infinite variety of station layouts, while helping you save installation time and money.

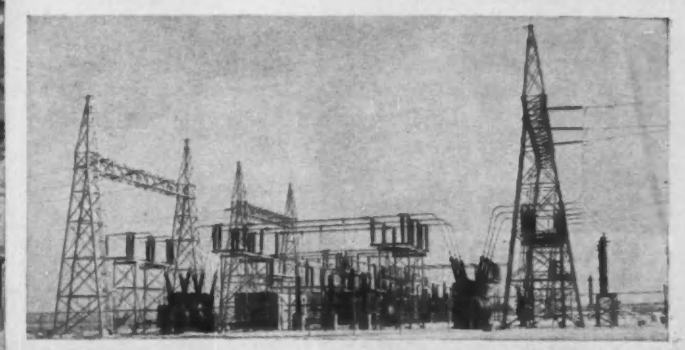
An almost infinite number of station layouts is possible because of the variety of structural styles available. Latticed-column or rolled-shape structures are available in galvanized steel or aluminum. Stands, pedestals, trusses, and towers are available for mounting station equipment and components.

You save time and money, because delivery of structural items and other station components is co-ordinated with your installation schedule. There's no waiting, and yet no unnecessary handling and storage of parts.

Why settle for less? Contact your G-E Sales Engineer for more information. Or write to Section 495-10, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



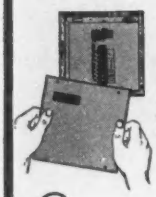
FROM A VARIETY OF STRUCTURAL STYLES offered by G.E., lattice-work structures were chosen for termination structures and equipment stands in the switching station for Unit No. 5 at the Oak Creek Power Plant near Milwaukee, Wis.

GTC

UNITIZED
COMMUNICATION EQUIPMENT for POWER and INDUSTRY

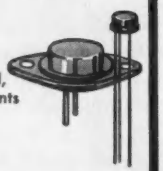
Effective! Reliable! Economical!

1 Highly effective in extremes of ambient noise and temperature.



2 Plug-in units provide ease of installation, expansion and maintenance.

3 Transistors and rugged, industrial type components used throughout.



4 Central control cabinet, costly engineering and fabrication eliminated.

Wherever a highly dependable, voice communication system for use in high noise level areas is needed—you'll find GAI-TRONICS specified by name.

GTC is extremely flexible in application. Write today for a copy of our completely illustrated, descriptive booklet and name of nearest representative.

GAI-TRONICS
CORPORATION
Dept. A
READING, PENNA.

GAI
FOUNDED 1905

A SUBSIDIARY OF
GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS

PERSONAL BRIEFS

Toledo Edison Co has made **Paul R. Hansen** director of systems and procedures, in charge of planning, scheduling, and directing work in research, design, installation, and improvement of management information and control, data processing, and related procedures.

Peter R. Beament, engineering assistant at Virginia Electric & Power Co's Chesterfield Power Station near Richmond, has been assigned to the Carolinas-Virginia Nuclear Power Associates. He will have operations duties at the atomic power plant under construction at Parr, S. C.

Arkansas Power & Light Co has assigned **Lewis C. Walker** to succeed **John P. Graham** who resigned as manager of the Brinkley area, and **Jack L. Wilson** to replace Walker as Earle area manager. **Earl Bowman** took Wilson's place as office assistant in the Newport office.

Paul M. Miller and **John W. Chapman** have been named to Potomac Light & Power Co's merchandising sales staff.

Harry Buchanan has retired from the accounting division of Illinois Power Co.

Successor to the late **M. T. Reeves** as residential sales engineering division manager is **Courtenay Bythewood,** former field supervisor for the division.

The superintendent of electric production for Cincinnati Gas & Electric Co, **Edward H. Mitsch,** has retired.

Wayne H. Johnson has replaced the late **W. J. Mandley** as assistant manager of the Cowlitz County Public Utility District in Washington.

George C. Love has replaced **Robert O. Grimes** as chief engineer in the Richland, Wash., office of H. E. Bovay Jr, consulting engineers. Grimes has assumed duties as associate of the Houston organization, senior project engineer, and assistant projects manager.

Theodore M. Chubb has been appointed director of the Pacific Southwest division of H. Zinder & Associates, consultants.

Dorman M. Miller and **Julian C. Hansbarger** have been appointed executive assistants of Appalachian Power Co. Also, **William E. Keck** has retired as division right-of-way supervisor, and **J. R. Martin,** line and station supervisor, has been given a 40-year service award.

Southern California Edison Co has promoted **H. L. Perry** to district manager's representative in Covina.

J. B. Sparrow has been appointed superintendent of Kentucky Utilities Co's E. W. Brown Generating Station and Dix Dam Lock No. 7, succeeding the late **George Dewey Glass.**

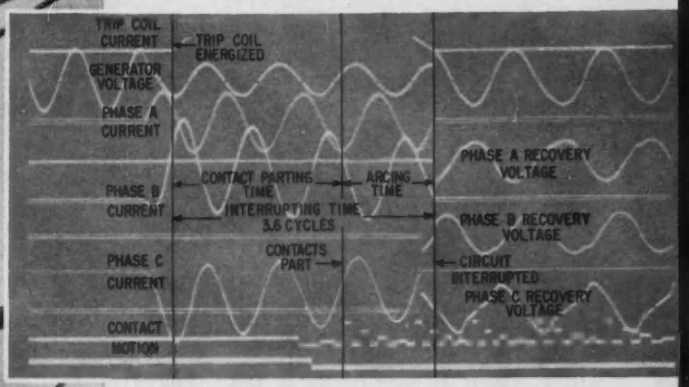
Charles S. Betts Jr has been appointed assistant to the president of Virginia Electric & Power Co. Betts' successor as Potomac district manager, Alexandria, Va., is **Leon D. Johnson III.**

At Saskatchewan Power Corp, the electrical engineering division has been divided into an electrical design division and a construction division. **W. R. Wiggins** will head the former and **Don J. Anderson** the latter. **Percy Kell** will be superintendent of the electrical construction department and **Fred G. Ursel** of the powerline construction department, both in the construction division. With **Harold Kaldor** as its new head, the communications department, formerly under the electrical engineering division, will report directly to the assistant general manager in charge of engineering.

Clarence Feitknecht Jr has become superintendent of Flynn Power Station, Duquesne Light Co, and **P. H. Barnes,** former superintendent of Elrama Power Stations, has become investigating engineer, power stations department.

Gerald J. Griffin has been named manager of corporate contracts and records in the corporate group of

(*Continued on page* 142)



Five-cycle performance of G-E one-tank sub-transmission breakers is demonstrated in the oscillogram above. Conventional breakers are rated to interrupt in eight cycles. Photo shows one of 17 G-E one-tank breakers installed by The Potomac Edison Company, Hagerstown, Md.

WITH GENERAL ELECTRIC ONE-TANK SUB-TRANSMISSION BREAKERS, YOU CAN . . .

Cut Interruption Time to Five Cycles

Five-cycle performance of General Electric's one-tank sub-transmission breakers (15 kv through 46 kv) provides superior system protection. This is a full three cycles faster than industry requirements for breakers of this class. Here's what quicker interruption means to you:

- Chances of line burn-down are reduced;
- Inspections and maintenance can be reduced, because oil carbonization and contact wear are minimized.

Five-cycle interruption is possible because of the interrupter efficiency and compactness of the G-E one-tank breaker. Since linkages are shorter and lighter, contacts part in 2½ cycles or less. Field-proven oil-blast interrupters also help decrease interrupting time.

Why settle for less? For more information, contact your G-E Sales Engineer. Or write to Section 494-01, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Arizona Public Service Co. **James K. Wellington** has succeeded Griffin as wage and salary supervisor in the management services group.

The assistant vice president-sales of Long Island Lighting Co, **William J. Schmidt,** has retired.

Dayton Power & Light Co has named **Louis C. Cobb** supervisor of market analysis and **John W. Strevell** supervisor of rates.

R. E. Doyle Jr, vice president and general manager of Indiana & Michigan Electric Co, has been elected president of the Indiana Electric Assn. Also elected were: **Ottis T. Fitzwater,** Indianapolis Power & Light Co president, as vice president; and **A. C. Crandall,** also of Indianapolis P&L, as secretary-treasurer.

Hawaiian Electric Co has expanded its industrial development section into an "area development office," with section head **Rollin C. Bacher** in charge of the new office.

Edward C. Gralapp has retired as construction superintendent for Washington Water Power Co.

L. M. Welch, former assistant to the executive vice president, has been promoted to general manager of operations at Gulf States Utilities Co, succeeding **George R. Fulton** who retired.

Illinois Power Co has promoted **Lerton Krushas** to district manager at Litchfield, replacing **Roy A. Stroyeck** who became manager at Edwardsville.

Kenneth P. Locke has become assistant controller of Detroit Edison Co.

David H. Gulvin has succeeded **William J. Naughton** as employee and community relations coordinator for Connecticut Light & Power Co.

L. Thomas Leonard has been promoted to site service manager for Jersey Central Power & Light Co and New Jersey Power & Light Co.

John J. Egan has joined the industrial consultant staff of Middle West Service Co.

Texas Electric Service Co has named **Theo A. Willis Jr** to succonsultant on Ft. Worth division Division commercial manager. Davis assumed special duties as consultant on Ft Worth Division commercial activities.

Joseph E. Dean Jr has been appointed McGraw-Edison Co general counsel.

T. L. Taylor has been boosted to group merchandising manager in the central marketing staff, in charge of welding products and electric motors, at A. O. Smith Corp.

Neil K. Barr has been appointed technical manager of the electrical conductor division of Kaiser Aluminum & Chemical Sales, Inc. Also, **John B. Roche** became chief engineer for overhead conductor products, and **Roger S. Keith** has been named chief engineer for insulated products.

At General Electric Co the following appointments have occurred: **T. Richard Rhea** to manager-construction engineering operation for the new power plant engineering operation; **Kenzel P. Manning** to manager of the newly-formed peripheral equipment engineering group; **Robert M. Cohen** to manager-superheat reactor physics in the atomic power equipment department; **George B. Doughman** to manager of the producer goods export department of the international GE division; **Andrew F. McNally Jr** to manager-manufacturing for the small steam turbine department; **Raymond H. Carey** to sales engineer for the heating and special purpose controls in the appliance control department. **Harry W. Lawson** has been appointed manager-atomic power plant market development. Fourteen regional sales operations have been established to serve the electric utility industry. The regions, managers and central office locations are: New York, **Arthur M. Wainwright,** New York City; Atlantic, **William F. Henn,** Philadelphia; South Atlantic, **J. Frank McElwee Jr,** Charlotte, N. C.; Southeastern **Rudolph H. Jackson,** Atlanta; Southwestern, **Russell W. Miller,** Dallas; Pacific Southwest, **William A. Sredenschek,** Los Angeles; Pacific, **Arthur D. Bragg,** San Francisco; Pacific Northwest, **Henry C. Glaze,** Seattle; Rocky Mountain, **John F. Gogins,** Denver; Central, **L. William Ballard,** Chicago; Michigan, **Clifford M. Dunn,** Detroit; East Central, **Simon J. Tombaugh,** Cleveland; Mid-states: **Thomas F. Skinner,** St Louis; New England, **W. Hardy Prentice,** Boston.

At Allis-Chalmers Manufacturing Co, the following appointments have been made: **Will Mitchell Jr,** acting director, research division, succeeding the late **Dr H. K. Ihrig; C. L. Brisley** and **L. M. Dings Jr,** chief industrial engineer and chief production engineer, respectively, in the West Allis Works; **R. C. Allen,** senior engineering consultant, and **L. J. Linde,** director of engineering services, both in the newly-formed engineering services group; **John Gammell,** director, professional development, and **John T. Graham,** director of graduate training, both in the industries group; **Walter W. Edens,** assistant director of the research division; **J. S. Quinn,** manager of the Omaha district office, industries group; and **R. A. Frazee,** manager of heavy industrial sales, St. Louis.

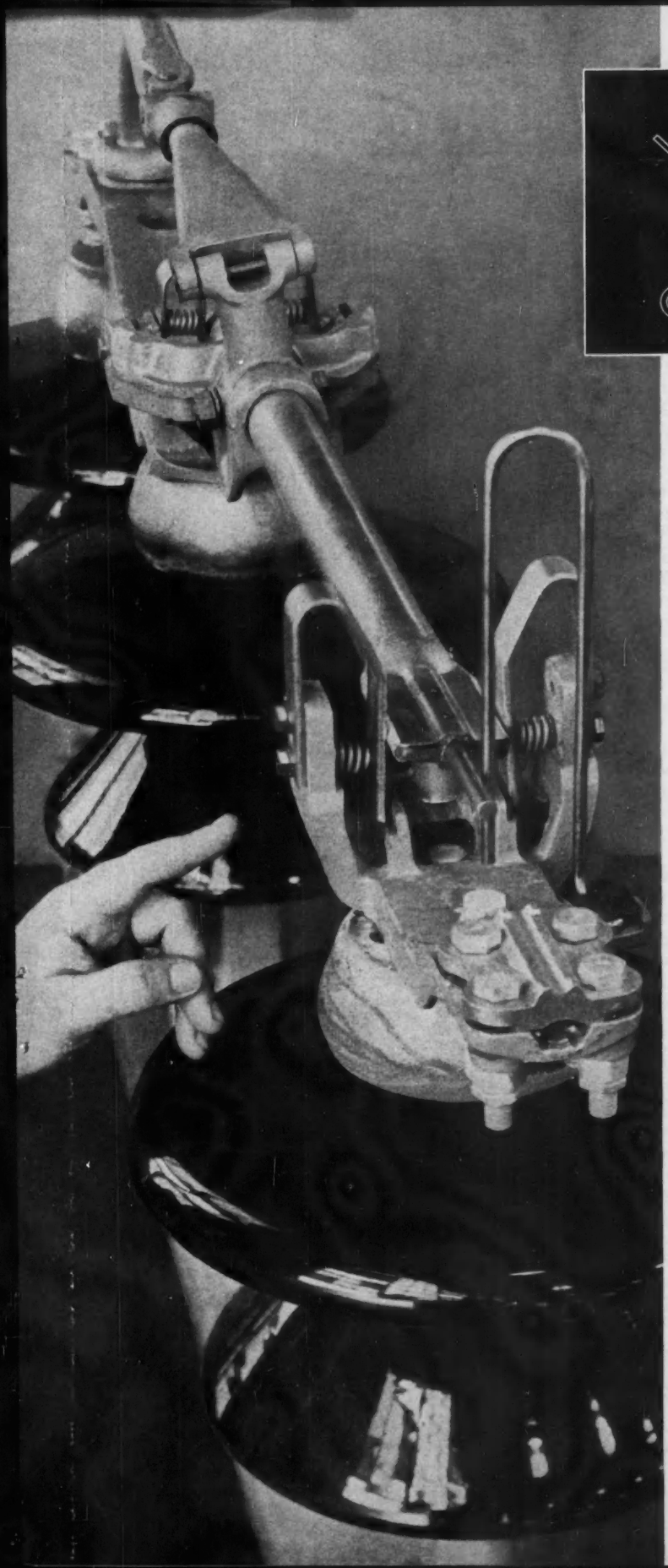
James R. Johnstone has been named president of National Carbon Co, a division of Union Carbide Corp. **Fred B. O'Mara** has been made vice president–production.

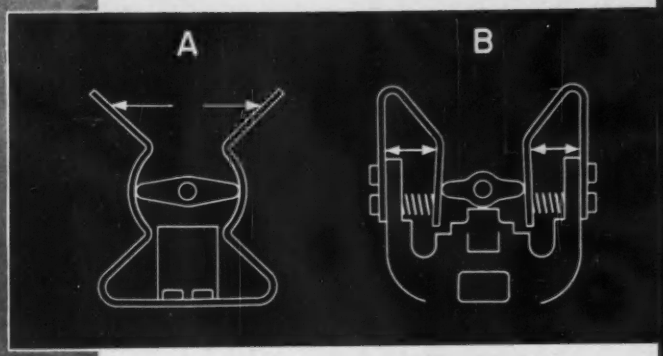
Dause L. Libby has been made president of the Remington Rand Division, Sperry Rand Corp.

Electro-motive division of General Motors has made **Leroy R. Beck** sales engineer, **Norman C. Steinberger** application engineer in the product application section, and **H. L. Smith Jr** assistant chief engineer.

OBITUARIES

O. Titus, 67, president of Metropolitan Edison Co . . . **T. G. A. Sillers,** 57, manager of power systems engineering department, Allis-Chalmers Manufacturing Co . . . **Charles A. Bigelow,** 78, retired vice president and West Coast district manager, Stone & Webster Engineering Corp.





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Feeder Cables Get Stiffer Tests

Opinions vary on whether tests for longer periods at higher voltages cause more failures than they prevent; importance of soil tests along key cable routes is emphasized as guide to cable capability

■ Periodic tests that try more severely the network feeder cables of metropolitan power companies absorbed the attention of the fall meeting of the Edison Electric Institute's Transmission and Distribution Committee at St. Louis, Mo.

Talks turned on higher voltages and longer applications of dc dielectric tests for detecting incipient cable failures that could produce large-scale power interruptions. Some meeting participants, however, expressed reservations on the advisability of the more severe tests, opining that the stepped-up dc proof-test procedures might increase the failure rate of cables in service.

New York, Boston, Chicago, and Cleveland spokesmen discussed this subject.

Spurred by its August 1959 failures of 13-kv feeders to the Central Park network, Consolidated Edison Co has since applied a 40-kv dc test for 5 min. The company formerly tested for 1 min at 25 kv.

Before use of the new voltage, the failure rate in service was 3.6 per feeder per year, said T. C. Duncan. But since the application of the new test, the in-service failure rate has dropped to 3.1 per year.

Duncan noted that 56 of the 66 feeders out of Hell Gate Station, power source of the network that blacked out, have been tested by the new procedure. Of these, 23 (41%), he said, withstood 40 kv for 5 min. Of the other 33 cables, 22 stood this test after one failure had been repaired, seven after two repairs, and one after three.

Of 42 test failures, nine were in terminations, 12 in joints, and 21 in cable runs. In installations less than ten years old, there were four cable failures, but there were only two failures in cables older than 30 years.

The dc test has not been the basic cause of cable failures in service, said D. F. Tulloch, who cited Boston Edison Co's 30 years of testing underground high-voltage cables. His company's experience, he said, showed that solid-type cables failed for other reasons. Analysis of test failures from 1951 to 1955, he said, indicated that moisture was associated with 80.7% of the test failures.

Other conclusions from this analysis, he said, were these: Testing revealed faults in terminals, substations, and vaults, which, had they occurred in service, would have resulted in worse damage and more costly repair; and, when testing was increased, the test failure rate increased indeed, but the in-service rate declined.

But, in Chicago, an unexplained rise in the rate of in-service failures of 12-kv network feeder cables followed Commonwealth Edison Co's use of a more stringent test on feeders supplying the low-voltage network system. The new procedure, said A. Zanona, boosted the 24-kv dc tests for 1 min to 30 kv for 5 min.

A total of 130 tests, he said, resulted in 13 test failures; seven in cable and six in joints. Service failures were 16 in the 11 months following the introduction of the new test program in 1959. Of these service failures, 11 were in cable and five in joints, and of the total three were caused by workmen digging.

F. Williams described Cleveland Electric Illuminating Co's plans for preventing recurrence of failures in a duct network of dc cables encircling Cleveland's Public Square. These include:

1. Ventilated manhole covers to reduce explosions

2. Schedule routine cable tests

3. A short-time program for testing any entire cable system where bad cables had had to be replaced

4. Development of cable dead-ends and splices that can be put together rapidly for temporary use in emergencies

5. Speed abandonment of dc.

Soil thermal resistivity studies, conducted jointly by EEI and AIEE, were reported by Philadelphia Electric Co's F. Finale. These, he said, showed that a 20% difference in soil density around cables can produce a 2 to 1 change in thermal resistivity and make a 25% difference in cable thermal capability.

Finale urged soil surveys along key cable routes, warning that some routes can draw moisture from the soil and that loose sand backfill can cut cable capability by a quarter.

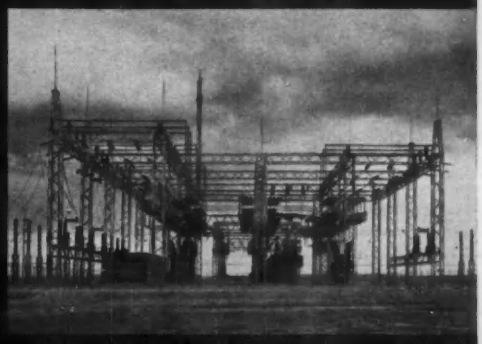
No impregnable defense has been developed against the attacks of piliated woodpeckers on wood H-frame transmission structures, so that utility engineers are reduced to evaluating the strength remaining after the birds have done their damage.

A structure-stress analysis by West Penn Power Co, reported John Armstead, showed that a third of the cross-sectional area of a pole can be lost without emergency measures being required. H-frame structures, he said, withstand considerable damage in some regions before there is any need to replace them. When caught in time, damage even in critical areas of stress concentration at the upper end of X-braces, can be taken care of, he said. Splices of timber or steel channels usually more than replace lost strength.

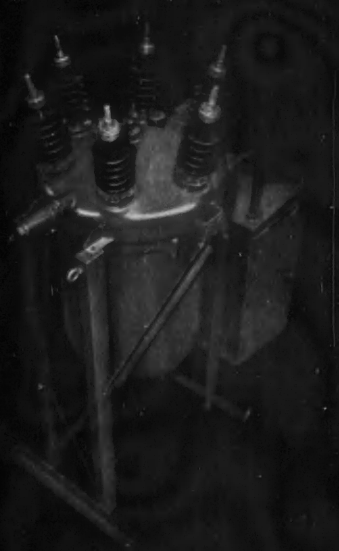
Economic sizing of primary distribution feeders to minimize primary investment and system losses was urged by F. F. Gray and A. W. Gebhardt, Union Electric Co. Such sizing, they said, offers substantial savings based on thermal and voltage limitations.

For their own company's system, the speakers estimated the 1960 primary loss savings at 5,300 kw on primary conductors installed in accordance with economic sizing in 1959. When annual cost of peak loss is put at $44.77, estimated savings would be about $235,000.

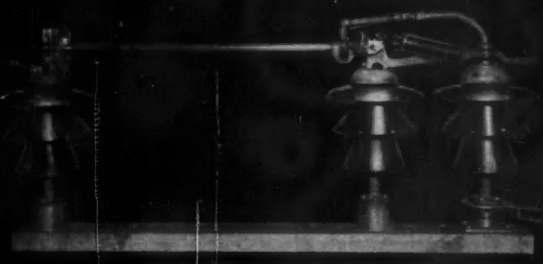
Single column of Type ATB air-blast power circuit breakers—115–460 kv.



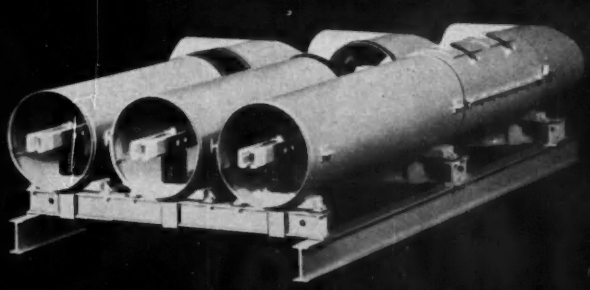
Completely designed and coordinated outdoor stations—7.5–230 kv.



Single-tank sub-transmission breakers—14.4–46 kv.



Disconnect switches—7.5–345 kv.



Isolated phase bus—14.4–34.5 kv, through 20,000 amps.

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DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5440) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, December 15, 1960, for furnishing three 230-kv, 5,000,000-kva, 1,200-ampere power circuit breakers for Watertown Substation, Missouri River Basin Project, South Dakota. Delivery is desired within 360 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner

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Meetings Calendar

NOVEMBER

American Society of Mechanical Engineers—Annual Meeting, Statler Hilton Hotel, New York City, Nov. 27-Dec. 2; 24th National Exposition of Power & Mechanical Engineering, Coliseum, New York City, Nov. 28-Dec. 2.

Edison Electric Institute—Electronics Seminar, Claridge Hotel, Atlantic City, Nov. 28-30; Street & Highway Lighting Committee, Cincinnati, Nov. 30-Dec. 1.

National Association of Railroad & Utilities Commissioners—Annual Meeting, Stardust Hotel, Las Vegas, Nevada, Nov. 28-Dec. 1.

American Institute of Consulting Engineers—Annual Dinner, Waldorf Astoria Hotel, New York City, Nov. 29.

DECEMBER

Edison Electric Institute—Industrial Power & Heating Group, Clearwater, Dec. 1-2; Residential Appliance Promotion Committee, Cleveland, Dec. 1-2; Market Research Committee, New York City, Dec. 5; Commercial Lighting Committee, Philadelphia, Dec. 5-7; Industrial Relations Committee, Roosevelt Hotel, New York City, Dec. 8; Street & Highway Lighting Committee, Cincinnati, Dec. 8-9; Residential Electric Heating & Air Conditioning Committee, Cincinnati, Ohio, Dec. 15-16.

National Conference on Application of Electrical Insulation—Conrad Hilton Hotel, Chicago, Dec. 5-9.

Interstate Power Club—Beverly Hotel, New York City, Dec. 12.

American Nuclear Society—Winter Meeting, Mark Hopkins Hotel, San Francisco, Dec. 12-15.

• **Electric Companies Public Information Program**—Steering Committee, Edgewater Beach Hotel, Chicago, Dec. 13.

National Safety Council—Fall Meeting of the Executive Committee, Public Utilities Section, New York City, Dec. 13-14.

Eastern Joint Computer Conference—New Yorker Hotel and the Manhattan Center, New York City, Dec. 13-15.

Atomic Industrial Forum—Annual Conference, Fairmont Hotel, San Francisco, Dec. 14-16.

JANUARY

• **Symposium on Thermoelectric Energy Conversion**—Statler-Hilton Hotel, Dallas, Jan. 8-12.

• **Reliability & Quality Control Conference**—Sponsored by the AIEE-IRE-ASQC, Bellevue-Stratford Hotel, Philadelphia, Jan. 9-11.

• **Edison Electric Institute**—Home Service Committee, Chicago, Jan. 11; Live Better Electrically Women's Conference, Edgewater Beach Hotel, Chicago, Jan. 12-14.

• **Instrument Society of America**—Winter Instrument-Automation Conference & Exhibit, Kiel Auditorium, St. Louis, Jan. 17-19.

• **Canadian Electrical Association**—Eastern Zone, Nova Scotian Hotel, Halifax, N. S., Canada, Jan. 23-26.

• **Southeastern Electric Exchange**—Legal and Claims Committee, Miami Beach, Jan. 25-26.

• **Pennsylvania Electric Association**—Communications Committee, Jan. 26-27; Structures and Hydraulics Committee, Philadelphia, Jan. 26-27.

• **American Institute of Electrical Engineers**—Winter General Meeting, Hotel Statler, New York City, Jan. 29-Feb. 3.

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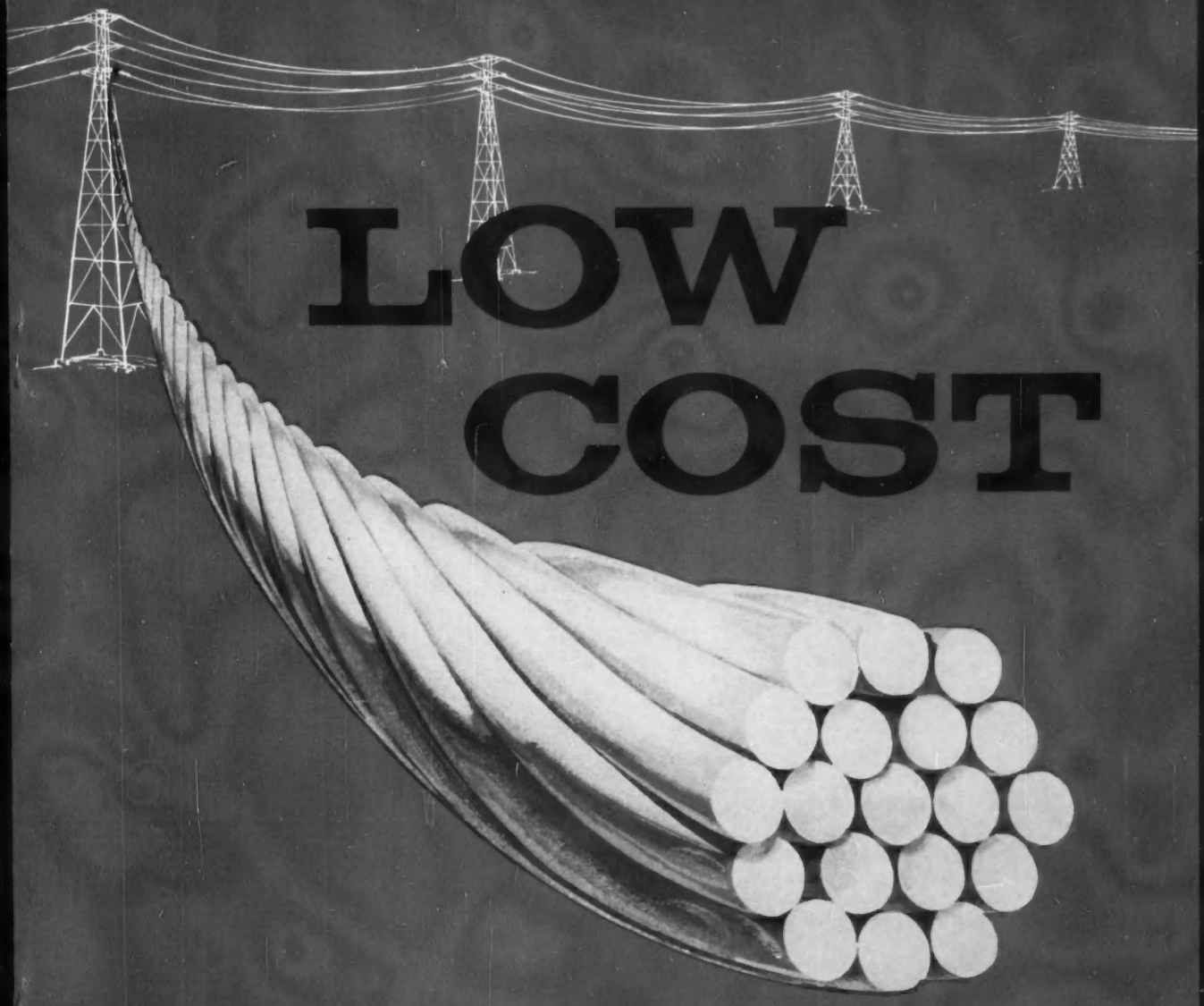

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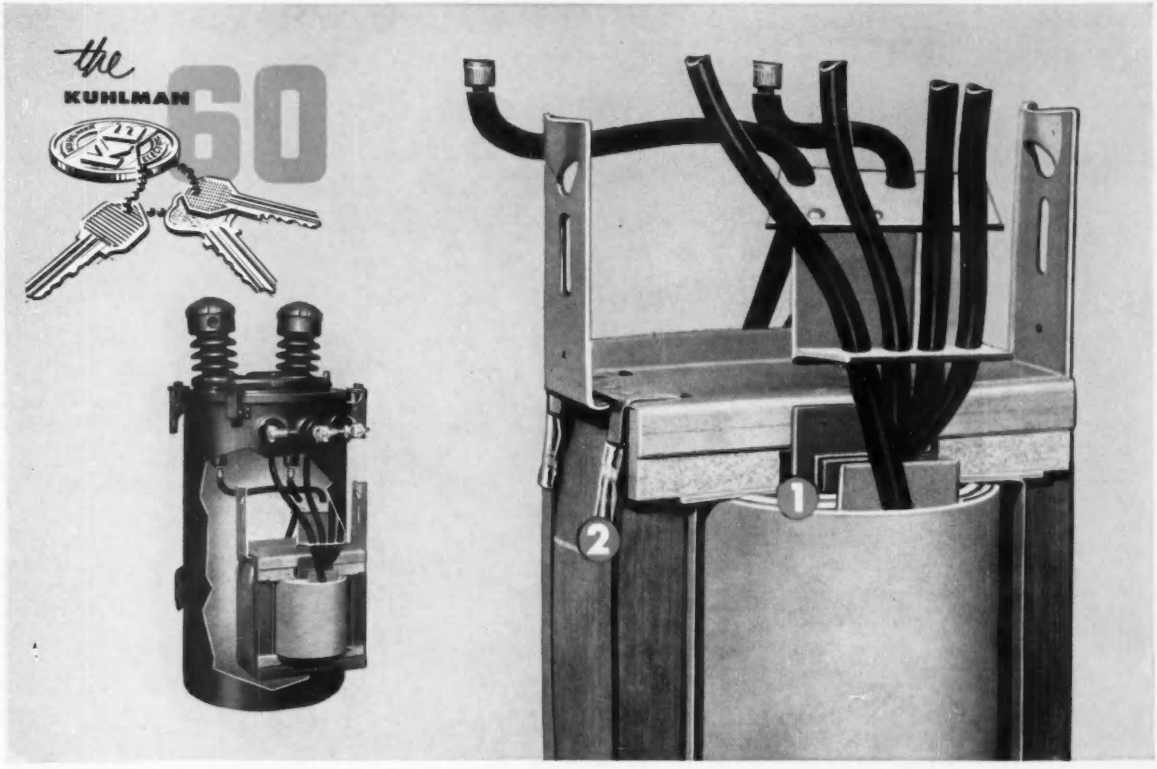

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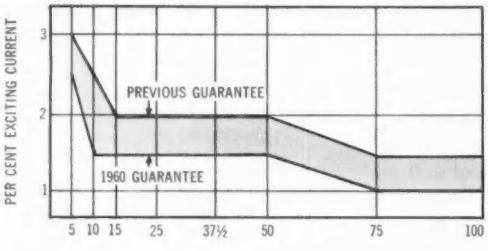

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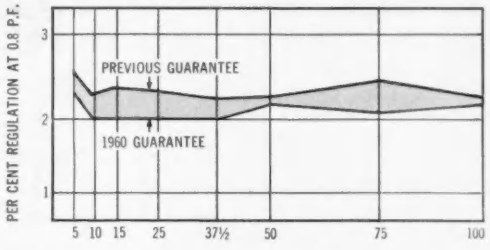

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